Drainage Report

150/200 Inner Belt Road

Somerville, Massachusetts

Prepared for **Cathartes Investments**
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Boston, Massachusetts 02109

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Date 5/23/00

Table of Contents

List of Figures

List of Tables

Appendices

1

Executive Summary

The 8.45-acre project site (the Site) is located at the southerly side of Inner Belt Road. The Site is presently occupied by gravel roads, bare ground, piles of construction material debris, scarce vegetation, railroad tracks, railroad ties and other evidence of railroad operations. The land is presently only being used as access to remaining railroad property. Under pre-existing conditions, stormwater runoff was collected in area drains in between railroad tracks and flowed southeasterly through a closed piping system. This closed piping system conveyed the stormwater runoff from the locus property through a 24" concrete pipe outfall pipe to land currently owned by the Massachusetts Bay Transportation Authority (MBTA).

The proposed redevelopment of the Site includes the construction of two four-story buildings, utility connections, grading, parking facilities, stormwater management system and landscaping. The proposed buildings will serve internet and telecommunications tenants. Under the proposed conditions, the stormwater runoff will be collected from the parking lots and roof tops and routed through an underground detention system to attenuate peak discharge rates. The westerly parking lot will also have an infiltration system that will recharge stormwater runoff in compliance with the Somerville Zoning Ordinance (SZO). Wherever possible pre-existing drainage and grading patterns were maintained in the proposed design. Additionally, the proposed design includes numerous water quality and quantity control measures designed to protect the surrounding natural resources from degradation as a result of stormwater runoff.

A HydroCAD model, using TR-20 methodology, was developed to evaluate the pre-existing and proposed drainage conditions on the Site. Table 1 presents a summary of the pre-existing and post-development peak discharge rates for the Site:

Table 1:
Peak Discharge Rates (cfs*)

Design Point	*2-year*	*10-year*
Flow from Site only to the 24" pipe		
Pre-Existing	17.11	27.56
Proposed	10.64	22.50
Flow to the 24" pipe including 121 Inner Belt		
Pre-Existing	21.52	33.85
Proposed	13.60	26.80

* expressed in cubic feet per second

The results of the analyses indicate that there is no net increase in peak discharge rates between the pre-existing and post-development conditions. The impacts and potential flooding downstream of the site during a 100-year storm event will not be increased. The hydraulic capacity of the 24" pipe will limit the amount of flow that can discharge downstream. The runoff from a 100-year storm event will result in local ponding on site and some overland flow to the Inner Belt Road drainage system.

2

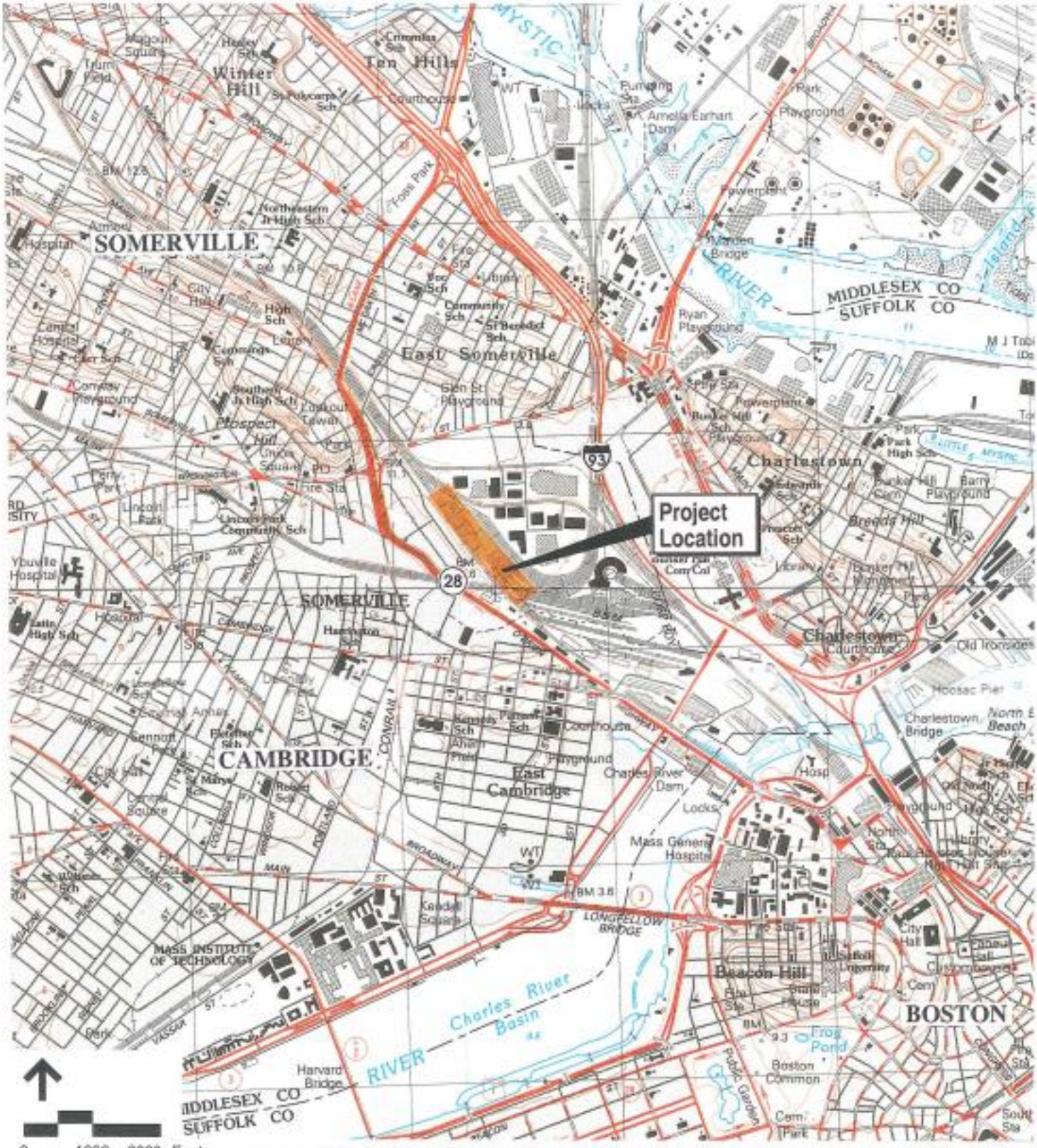
Introduction

The 8.45–acre project Site is located at Inner Belt Road in Somerville, Massachusetts (see Figure 1). The Site is bounded by Inner Belt Road and vacant land owned by ELB Realty Trust to the north, Boston and Lowell railroad and Massachusetts Bay Transportation Authority (MBTA) railroad to the south, MBTA railroad and a parking lot to the east, and MBTA railroad to the west. The Site is currently zoned Industrial "A" (IA). The Site is located within the surface watershed of the Charles River. There are no wetland or floodplain resource areas on or within 100 feet of the Site.

Currently, the Site is vacant and only used as access to the existing railroad property. Under pre-existing conditions, untreated stormwater runoff flowed from railroad track and railroad ties to swales between the railroad lines. The runoff was then collected in area drains and conveyed through a closed piping system easterly along the railroad tracks. The piping system consisted of 8" laterals that picked up the area drains and larger collector drains that transported the flow through the railroad yard (see Figure 2). The runoff eventually discharged into the Millers River.

The proposed redevelopment of the Site includes construction of two four-story-buildings, utility connections, grading, parking facilities, stormwater management system and landscaping. The proposed buildings will serve internet and telecommunications tenants.

The Stormwater Management Plan (the Plan), including Best Management Practices (BMPs) for maintaining stormwater runoff quality both during and after construction, was prepared in accordance with the applicable local, state, and federal regulations. Details of the Plan are provided herein.



Source: USGS Quadrangles; Boston North, MA and Boston South, MA

Vanasse Hangen Brustlin, Inc.

Site Location Map

Figure 1

3

Existing Conditions

The approximately 8.45–acre Site was previously used as a railroad yard by the Boston and Maine Corporation and is currently vacant (see Figure 1 and 2). The pre-existing topography was generally flat in the east west direction along the railroad and gradually sloped downward from south to the north perpendicular to the railroad tracks. The entire site was covered with railroad track, railroad ties, ballast (crushed stone) and other railroad equipment and facilities.

For the pre-existing conditions hydrologic analysis, the site was divided into two drainage areas, that contribute to a single design point, where the peak discharge rate was evaluated. One drainage area is the entire project Site. The other drainage area is for 121 Inner Belt Road (located across the road).

The pre-existing drainage pattern is generally the same for the entire Site. The stormwater would run off the railroad tracks and railroad ties and flow to the swales in between the railroad lines. This flow would then be collected in area drains and conveyed easterly through the site to the 24" pipe (see Figure 2). This pipe, which was part of the old Boston and Maine railroad drainage system, connects the Site with land that is currently owned by the MBTA. This drainage system is connected to the new Fitchburg Mainline Drain that was constructed in 1992. The Fitchburg Mainline Drain consists of piping and an oil/water separator that discharges into the New Main Drain and eventually drains to the Millers River.

The Middlesex County Interim Soil Survey indicates the soils in the project area are Udorthents with a wet substratum. These soils are described as "gently sloping areas that were previously tidal marsh, flood plains, bays, harbors, and swamps that have been filled. Fill consists of various types of soil material, rubbish and refuse. Depth of fill ranges from 2 to 20 feet or more." According to soil boring and test pit explorations performed for this project, the entire Site is underlain by urban fill with a sub-stratum of brown clay and silt. The results of the soil explorations confirm the information in the soil survey. The soil survey indicates the soils in this area are a hydrologic soil group type B. The brown clay and silt layer of soil will have a low infiltration rate and eliminate or impede the downward movement of water through the soil. This will make it difficult to recharge a large amount of stormwater runoff.

The estimated seasonal high ground water table was determined by the BSC Group to be elevation 15.5 feet. Soil mottling was observed in three test pits to make this determination.

Table 2 summarizes the key hydrologic parameters for each drainage area used in the existing conditions analysis.

Table 2:
Existing Conditions Hydrologic Data

Description (Drainage Area)	Discharge Location	Design Point	Area (acres)	Curve Number	Time of Concentration (min)
Site (1)	24" pipe	1	8.45	89	11
# 121 Inner Belt (2)	24" pipe	1	2.2	98	3.4

4

Proposed Conditions

The project, which will include the construction of two four-story buildings, parking lots, utility work, earthwork, stormwater management system and landscaping, was designed to comply with the City of Somerville Zoning Ordinance requirement of no increases in the amount of runoff that discharges from a project site and reduction in the peak rates of runoff for the 2 and 10-year storm events to the 24" pipe requested by the MBTA.

Pre-existing drainage and grading patterns were maintained to the maximum extent possible.

For the proposed conditions hydrologic analysis, the site was divided into two drainage areas (see Figure 3). One drainage area is the entire project Site. The other drainage area is 121 Inner Belt Road (located across the street). Both areas discharge to the design point where the peak discharge rate was evaluated.

The proposed drainage system consists of catch basins, closed piping, an infiltration system, Stormceptor® water quality structures, roof drain connections and an underground detention system.

- The catch basins are equipped with deep sumps and hooded outlets.
- The closed piping system was designed using StormCAD, a HEC 22 hydraulic model, using a 10-year storm event.
- The infiltration system recharges an amount of stormwater that will result in a no net increase in the amount of stormwater that discharges from the Site. This is a City of Somerville Zoning Ordinance requirement.
- Stormceptors® will be installed in each of the parking lots to provide water quality treatment for the majority of the Site prior to discharge to the infiltration system and to the detention system.
- The roof drain connections will be directly connected to the closed piping system.

- The underground detention system was designed using 4-foot by 8-foot box culverts to provide the storage volume required and outlet pipes that will reduce the peak rates of runoff from the Site.

Table 3 summarizes the key hydrologic parameters for each drainage area used in the proposed conditions analyses.

Table 3:
Proposed Conditions Hydrologic Data

Description (Drainage Area #)	Discharge Location	Design Point	Area (acres)	Curve Number	Time of Concentration (min)
West Parking Lot (1)	24" pipe	1	1.58	94	4.3
Remainder of Site (2)	24" pipe	1	6.87	94	3.0
# 121 Inner Belt (3)	24" pipe	1	2.20	98	3.4

The Site, which is not in the jurisdiction of the City of Somerville Conservation Commission or the Massachusetts Department of Environmental Protection granted by the Massachusetts Wetlands Protection Act (310 CMR 10.00), has been designed using a number of non-structural and structural Best Management Practices (BMP) in order to provide water quality treatment of stormwater. The Massachusetts State Stormwater Management Performance Standards and Guidelines was used as a guide for the selection of structural Best Management Practices (BMP) and the calculation of total suspended solid (TSS) removal rates for the project (see Appendix C).

5

Hydrologic/ Hydraulic Analysis

Hydrologic Analysis

The rainfall-runoff response of the Site under pre-existing and proposed conditions was evaluated for storm events with recurrence intervals of 2 and 10-years. Rainfall volumes used for this analysis were based on the Natural Resources Conservation Service (NRCS) Type III, 24-hour storm event for Middlesex County; they were 3.2 and 4.6 inches, respectively. Runoff coefficients for the pre-existing and post-development conditions, as previously shown in Tables 2 and 3 respectively, were determined using NRCS Technical Release 55 (TR-55) methodology.

Drainage areas used in the analysis of pre-existing and proposed conditions were described in previous sections and shown on Figures 2 and 3. The HydroCAD model is based on the NRCS Technical Release 20 (TR-20) Model for Project Formulation Hydrology. Detailed printouts of the HydroCAD analyses are included in Appendix D. Table 4 presents a summary of the pre-existing and proposed conditions peak discharge rates.

Table 4:
Peak Discharge Rates (cfs*)

Design Point	2-year	10-year
Flow from Site only to the 24" pipe		
Pre-existing	17.11	27.56
Proposed	10.64	22.50
Flow to the 24" pipe including 121 Inner Belt		
Pre-existing	21.52	33.85
Proposed	13.60	26.80

* expressed in cubic feet per second

The results of the analysis indicate that there is no increase in peak discharge rates between the pre-existing and post-development conditions for the 2 and 10-year storm events.

The infiltration system in the westerly parking lot was analyzed as a pond. The design utilizes the storage volume only and neglects infiltration during the storm event.

The 100-year storm event will not have a significant impact on downstream properties and will experience localized flooding in the parking lots. The flooding can reach an elevation of approximately 19 feet (NGVD 1929) before the stormwater will flow to Inner Belt Road. The finished floor elevations for the buildings are 22.0 and 22.8 (NGVD 1929) and should provide adequate protection from possible flooding.

Hydraulic Analysis

All hydraulic calculations were performed assuming that the structural integrity and hydraulic characteristics of the existing piping system are in good working order. VHB has performed field investigations to verify the status of the existing piping system, specifically the 24" outfall pipe from the Site. One or two lengths of pipe and accompanying manholes on the 24" outfall pipe were not able to be located due to site conditions. VHB recommends that the remaining lengths of pipe and manholes be field verified by television investigation during the construction phase of this project. All of the pipes that were visually verified, both upstream and downstream of the 24" outfall pipe, appeared to be in good working order.

The closed drainage system was designed for the 10-year storm event, in accordance with the City of Somerville and MBTA requirements.

Drainage pipes were sized using Manning's Equation for full-flow capacity and the Rational Method. Additionally, the performance of the system was analyzed using StormCAD, a HEC-22 based program. The highest stormwater elevation in the subsurface detention system, as calculated in the HydroCAD models, was used as the tailwater elevation for the StormCAD calculations. Pipe sizing calculations are included in Appendix D of this report.

6

Stormwater Management Plan

The purpose of the Stormwater Management Plan is to provide a comprehensive framework for the long-term protection of natural resources in and around the Site from degradation as a result of stormwater discharges. This is achieved through the use of a variety of water quality and quantity control measures designed to decrease the amount of pollutants discharged from the Site, increase the quality of stormwater recharged on the Site, and control discharge rates.

The following sections describe the regulations pertinent to stormwater management and the specific components of the Stormwater Management Plan to be implemented at the Site.

Stormwater Regulations and Permitting

The Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Stormwater Permit for Construction Activities disturbing greater than five acres (EPA, Federal Register, December 8, 1999) applies to the proposed site development.

The Massachusetts State Stormwater Management Performance Standards and Guidelines, Department of Environmental Protection and Office of Coastal Zone Management (DEP/CZM, March 1997) does not apply to this site but is being used as a guide for Best Management Practices selection and calculations of total suspended solids removal.

Stormwater Management Standards and Guidelines

The "Performance Standards" and "Guidelines for Stormwater Management" issued by the DEP/CZM were used as the foundation for the development of the site plan and the selection of structural Best Management Practices (BMPs) on the site. The Stormwater Management Plan (the Plan) includes numerous water quality and quantity controls designed to protect surface and groundwater resources and adjacent properties from potential impacts due to the proposed redevelopment project. The Plan addresses full-build conditions and construction activities.

The Stormwater Management Policy issued by the DEP/CZM states that the "use of the standards should prevent or minimize adverse environmental impacts due to unmanaged stormwater while limiting undue costs and recognizing site constraints." The following sections describe the specific components included in the Stormwater Management Plan designed to achieve this goal.

Water Quantity Control

The City of Somerville Zoning Ordinance states that "Drainage shall be designed so that groundwater recharge is maximized, and at the project boundaries the run-off shall not be increased in amount or velocity."

The volume that needs to be recharged in order to meet this requirement is the difference between pre-existing and the proposed development runoff volumes. The proposed infiltration system will recharge this volume under the westerly parking lot. This system is sized using the volume needed only, and does not take into account infiltration during the storm event.

The subsurface Site conditions are not feasible for recharge on a large scale. The proposed infiltration system is proposed to meet the SZO only and is directly connected to the closed piping system as an emergency overflow.

Water Quality Control

Stormwater quality at the site will be controlled through the implementation of several non-structural and structural Best Management Practices (BMPs), as described in the following sections.

Non-Structural Methods

Source Control. A comprehensive source control program will be implemented at the Site, which includes regular pavement sweeping, catch basin cleaning, and enclosure and maintenance of all dumpsters, compactors and loading areas. Further discussion of the maintenance plan is made in a subsequent section of this report.

Structural Methods

Several structural BMPs are proposed on the site to maintain water quality and minimize total suspended solids (TSS) and associated pollutant loads in stormwater runoff. As shown in the TSS worksheets in Appendix C of this report, the combination of the following BMPs will remove approximately 75-percent of the estimated TSS load for the Site.

Deep Sump/Hooded Catch Basins. Catch basins at the site are to be constructed with sumps (minimum 4-feet) and hooded outlets to trap debris, sediments and floating contaminants.

Subsurface Detention System. The detention system will be constructed of 4'x8' precast box culverts. The culverts shall be four sided with rubber gaskets.

Stormceptor® units. The Stormceptor® units are designed to treat the first 0.5 inch of runoff (first flush) for water quality.

Sediment Trap. The subsurface detention system will be constructed to provide adequate water quality volume storage below the discharge pipe.

Maintenance Program

The following maintenance program is proposed to ensure the continued effectiveness of the structural water quality controls.

- Inspect subsurface detention system once annually, in the spring, for structural integrity and accumulated sediment. Necessary structural repair and sediment removal will be performed immediately upon identification.
- Clean all catch basins twice annually to remove accumulated sand, sediment, and floatable products.
- Paved areas will be swept, at a minimum, 20 times per year.
- Routinely pick up and remove litter from the parking areas, islands and perimeter landscape areas in addition to regular pavement sweeping.
- Routinely inspect all dumpster and compactor locations for spills. Remove all trash litter from the enclosure and dispose of properly.

The BMP Maintenance/Evaluation Checklist is included as Appendix E at the end of this report.

■

Federal NPDES Construction-Related General Stormwater Permits

The proposed project will result in the disturbance of more than five acres of land and, therefore, will require the preparation and implementation of a Pollution Prevention Plan by the site contractor and owner in accordance with the Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) General Permit Program for Stormwater Discharges

from Construction Sites. Standard components of the Stormwater Pollution Prevention Plan that will be employed during the construction phases of the development by the site contractor are described in the following section.

Erosion and Sedimentation Control Techniques

The following erosion and sedimentation controls will be employed to minimize erosion and transport of sediment to resource areas during the earthwork and construction phases of the project.

Hay Bale Barriers

Hay bale barriers will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction site. Bales will be set at least four inches into the existing ground to minimize undercutting by runoff.

Silt Fencing

In areas where high runoff velocities or high sediment loads are expected, hay bale barriers will be backed up with silt fencing. This semi-permeable barrier made of a synthetic porous fabric will provide additional protection. The silt fences and hay bale barrier will be replaced as determined by periodic field inspections.

Catch Basin Protection

Newly constructed and existing catch basins will be protected with hay bale barriers (where appropriate) or silt sacks throughout construction.

Gravel and Construction Entrance/Exit

A typical, temporary crushed-stone construction entrance/exit will be constructed. A cross slope will be placed in the entrance to direct runoff to a protected catch basin inlet or settling area. If deemed necessary after construction begins, a wash pad may be included to wash off vehicle wheels before leaving the project site.

Vegetative Slope Stabilization

Stabilization of open soil surfaces will be implemented within 14 days after grading or construction activities have temporarily or permanently ceased, unless there is sufficient snow cover to prohibit implementation. Vegetative slope stabilization will be used to minimize erosion on slopes of 3:1 or flatter. Annual grasses, such as annual rye, will be used to ensure rapid germination and production of rootmass. Permanent stabilization will be completed with the planting of perennial grasses or legumes. Establishment of temporary and permanent vegetative cover may be established by hydro-seeding or sodding. A suitable topsoil, good seedbed preparation, and adequate lime, fertilizer and water will be provided for effective

establishment of these vegetative stabilization methods. Mulch will also be used after permanent seeding to protect soil from the impact of falling rain and to increase the capacity of the soil to absorb water.

Maintenance

- The contractor or subcontractor will be responsible for implementing each control shown on the Sedimentation and Erosion Control Plan. In accordance with EPA regulations, the contractor must sign a copy of a certification to verify that a plan has been prepared and that permit regulations are understood.

- The on-site contractor will inspect all sediment and erosion control structures periodically and after each rainfall event. Records of the inspections will be prepared and maintained on-site by the contractor.

- Silt shall be removed from behind barriers if greater than 6-inches deep or as needed.

- Damaged or deteriorated items will be repaired immediately after identification.

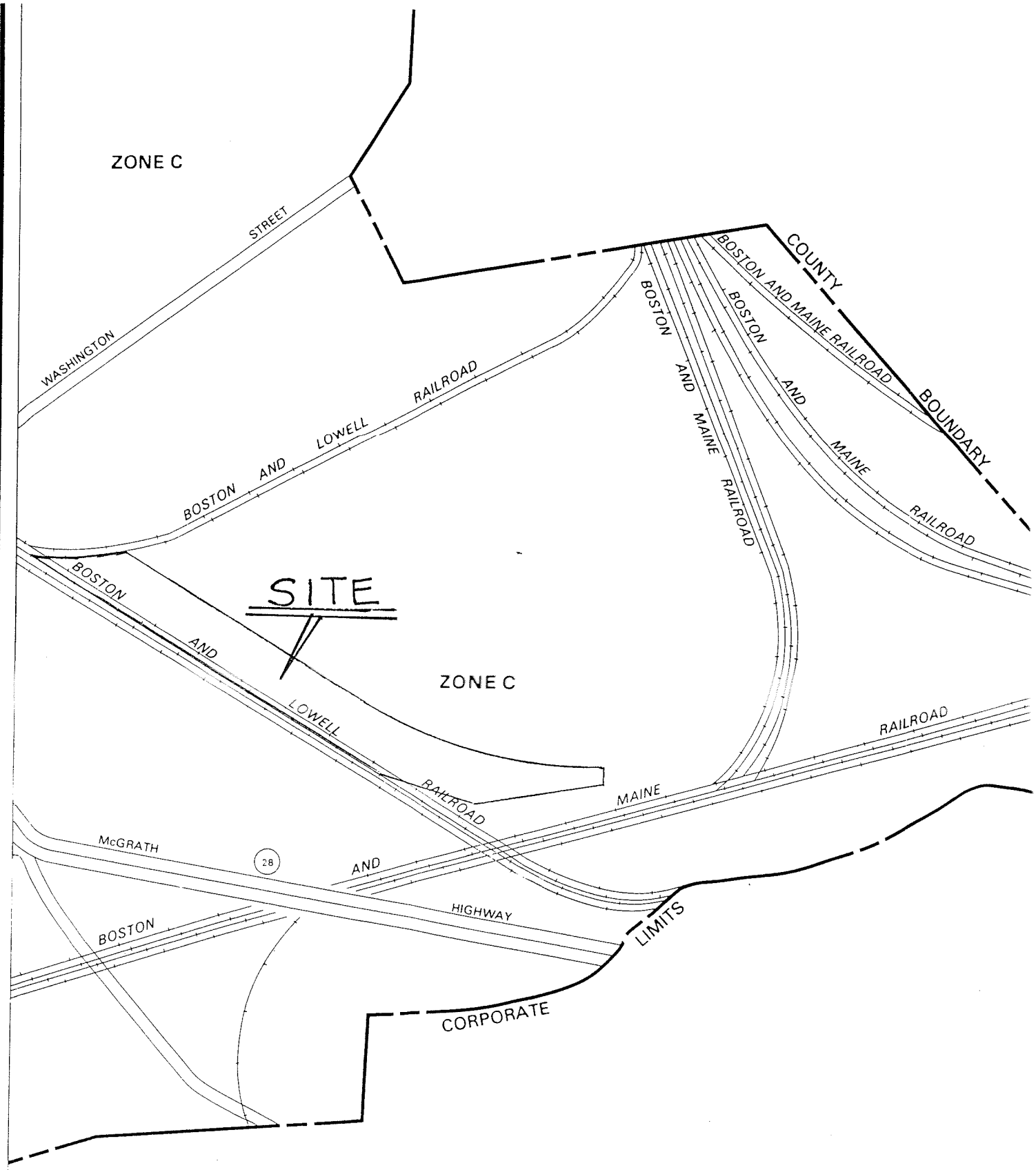
- The underside of hay bales should be kept in close contact with the earth and reset as necessary.

- Sediment that is collected in structures shall be disposed of properly and covered if stored on-site.

- Erosion control structures shall remain in place until all disturbed earth has been securely stabilized. After removal of structures, disturbed areas shall be regraded and stabilized as necessary.

A complete construction activity maintenance checklist is included in Appendix E. The sedimentation and erosion control plan is included in project plan set; a reduced version is included here as Appendix F.

Appendix A: Floodplain Information


ZONE C
WASHINGTON STREET
BOSTON AND LOWELL RAILROAD
BOSTON AND MAINE RAILROAD
BOSTON AND MAINE RAILROAD
BOSTON AND MAINE RAILROAD
COUNTY BOUNDARY
SITE
ZONE C
BOSTON AND LOWELL RAILROAD
BOSTON AND MAINE RAILROAD
McGRATH HIGHWAY
28
BOSTON
CORPORATE LIMITS

APPROXIMATE SCALE

500 0 500 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
SOMERVILLE,
MASSACHUSETTS
MIDDLESEX COUNTY

PANEL 2 OF 2
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
250214 0002 B

EFFECTIVE DATE:
JULY 17, 1986

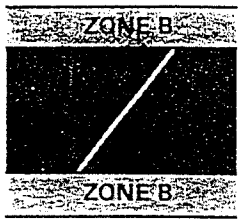
Federal Emergency Management Agency

KEY TO MAP

500-Year Flood Boundary

100-Year Flood Boundary

Zone Designations*



100-Year Flood Boundary

500-Year Flood Boundary

Base Flood Elevation Line With Elevation In Feet** — 513

Base Flood Elevation in Feet Where Uniform Within Zone** — (EL 987)

Elevation Reference Mark — RM7×

Zone D Boundary

River Mile — •M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For [illegible]

ZONE	EXPLANATION
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.

INITIAL IDENTIFICATION:

JULY 26, 1974

FLOOD HAZARD BOUNDARY MAP REVISIONS:

NOVEMBER 27, 1976

FLOOD INSURANCE RATE MAP EFFECTIVE:

JULY 17, 1986

FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

APPROXIMATE SCALE

500 0 500 FEET

Appendix B: NRCS Soil Survey Information


MEDFORD
SITE
260X
555
SCALE 1:25 000
KILOMETRES

UDORTHENTS consist of areas from which soil has been excavated and/or deposited due to construction operations. They occur on uplands, glacial outwash, glacial lake and coastal plains, and Urban land. These areas have been disturbed to the extent that the natural layers of soil are no longer recognizable and are no longer a major factor in determining limitations or capability of the land.

UDORTHENTS-URBAN LAND COMPLEX consists of nearly level to moderately steep, somewhat excessively to moderately well drained Udorthents and areas of Urban land. Although urban land development has altered the soils and landscapes in these areas, the soil can be identified at widely separated points, and the general nature of the area can be determined. Broad delineations are made on the map. This map unit consists of about 75 percent Udorthents and other soils and at least 25 percent Urban land and other disturbed areas. Urban land consists of streets, parking lots, buildings and other impermeable structures. For information on Udorthents soils see "Udorthents" series description.

UDORTHENTS, WET SUBSTRATUM consists of gently sloping areas that were previously tidal marsh, flood plains, bays, harbors, and swamps that have been filled. Fill consists of various types of soil material, rubbish and refuse. Depth of fill ranges from 2 to 20 feet or more.

URBAN LAND consists of areas where the soil has been altered or obscured by buildings, industrial areas, paved parking lots, sidewalks, roads and railroad yards. These structures cover 75 percent or more of the surface area. Slopes range from nearly level to steep.

WAREHAM series consist of nearly level and gently sloping, deep (5+ ft.), poorly drained soils on glacial outwash plains, terraces and deltas. They formed in sandy glacial outwash. Wareham soils have very friable or loose loamy fine sand to sand surface soil and subsoil over a very friable or loose stratified sand and gravel substratum at 24 to 36 inches. They have rapid permeability. They have a high water table at 6 to 18 inches for 7 to 9 months of the year. Major limitations are related to wetness.

WHITMAN series consist of nearly level, deep (5+ ft.), very poorly drained soils in depressions and drainageways of uplands. They formed in compact glacial till. Whitman soils have friable and loam or fine sandy loam surface soil and subsoil with moderate or moderately rapid permeability over a firm sandy loam, fine sandy loam or loam substratum (hardpan) at 10 to 30 inches which has slow or very slow permeability. They have a perched high water table at or near the surface most of the year. Whitman soils have a very stony or extremely stony surface, except where stones have been removed, and have stones below the surface. Major limitations are related to wetness, slow permeability and stoniness.

TABLE C.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Potential frost action	Uncoated steel	Concrete
					Ft			In			
267*:											
Paxton	C	None	---	---	1.5-2.5	Perched	Feb-Apr	>60	Moderate	Low	Moderate.
Urban land.											
268*:											
Haven	B	None	---	---	>6.0	---	---	>60	Moderate	Low	High.
Urban land.											
281A, 281B	C	None	---	---	1.5-3.0	Perched	Nov-Apr	>60	Moderate	Moderate	High.
Pittstown											
411	B	Frequent	Brief	Feb-Apr	4.0-6.0	Apparent	Nov-Apr	>60	Moderate	Low	Moderate.
Occum											
555*	B	None	---	---	>6.0	---	---	>60	---	---	---
Udorthents											
591A, 591B	B	None	---	---	1.5-2.0	Apparent	Mar-May	>60	High	Moderate	Moderate.
Scio											
601	C	None	---	---	0-2.0	Apparent	Nov-May	>60	High	High	Moderate.
Raynham											
602	C	None	---	---	0-1.0	Apparent	Nov-May	>60	High	Moderate	Moderate.
Raypol											
611	D	None	---	---	+1-1.0	Apparent	Oct-Jul	>60	High	High	High.
Birdsall											
GP*.											
Pits											
LF*.											
Udorthents											
Pq*.											
Pits											

* See description of the map unit for composition and behavior characteristics of the map unit.

Appendix C: TSS Removal Worksheet

VHB ***Vanasse Hangen Brustlin, Inc.***
Consulting Engineers and Planners
101 Walnut St., Watertown, MA 02172
(617) 924-1770

TSS Removal Calculation Worksheet

Name: 150/200 Inner Belt Road

Location: Somerville, MA

Proj. No.: 07027.00
Date: 5/17/00
Computed by: RPM
Checked by:

SYSTEM TYPE 1

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Sweeping	10	1.00	0.1	0.90
Deep Sumps and Hooded Catch Basins	25	0.90	0.23	0.68
Water Quality Structure	70	0.68	0.47	0.20
Sediment Trap	25	0.20	0.05	0.15

Total TSS Removal= **85%**

Notes:
*Starting TSS Load for first BMP= 1.00. TSS load for subsequent BMP's is equal to the Remaining Load (E) from the previous BMP.

VHB *Vanasse Hangen Brustlin, Inc.*
Consulting Engineers and Planners
101 Walnut St., Watertown, MA 02172
(617) 924-1770

TSS Removal Calculation Worksheet

Name: 150/200 Inner Belt Road

Location: Somerville, MA

Proj. No.: 07027.00
Date: 5/17/00
Computed by: RPM
Checked by:

SYSTEM TYPE 2

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Sweeping	10	1.00	0.1	0.90
Deep Sumps and Hooded Catch Basins	25	0.90	0.23	0.68
Sediment Trap	25	0.68	0.17	0.51

Total TSS Removal= **49%**

Notes:
*Starting TSS Load for first BMP= 1.00. TSS load for subsequent BMP's is equal to the Remaining Load (E) from the previous BMP.

VHB ***Vanasse Hangen Brustlin, Inc.***
Consulting Engineers and Planners
101 Walnut St., Watertown, MA 02172
(617) 924-1770

TSS Removal Calculation Worksheet

Name: 150/200 Inner Belt Road

Location: Somerville, MA

Proj. No.: 07027.00
Date: 5/17/00
Computed by: RPM
Checked by:

SYSTEM TYPE 3

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Sweeping	10	1.00	0.1	0.90
Deep Sumps and Hooded Catch Basins	25	0.90	0.23	0.68
Water Quality Swale	70	0.68	0.47	0.20
Sediment Trap	25	0.20	0.05	0.15

Total TSS Removal= **85%**

Notes:
*Starting TSS Load for first BMP= 1.00. TSS load for subsequent BMP's is equal to the Remaining Load (E) from the previous BMP.

VHB *Computations*

Project: 150/200 INNER BELT Project # 07027
Location: Somerville, MA Sheet of
Calculated by: RPM Date: 5/17/00
Checked by: Date:
Title WEIGHTED TSS REMOVAL RATE

OBJECTIVE: DO A WEIGHTED AVERAGE OF THE THREE SYSTEM TYPES REMOVAL RATES AND THEIR AREAS
* NEGLECTING ROOF TOP AREAS

INFORMATION:

SYSTEM TYPE	AREA (AC)	TSS REMOVAL RATE (%)
1	5.13	85
2	2.19	49
3	0.73	85
	$\Sigma = 8.05$	

CALCULATION:

$$\text{AVG. TSS REMOVAL RATE FOR PROJECT} = \frac{(5.13 \times 85) + (2.19 \times 49) + (0.73 \times 85)}{8.05}$$

$$= 75.2 \Rightarrow 75\%$$

VHB *Computations*

Project: 150/200 INNER BELT Project # 07027
Location: Somerville, MA Sheet of
Calculated by: RPM Date: 5/17/00
Checked by: Date:
Title SEDIMENT TRAP SIZING.

OBJECTIVE: SIZE VOLUME NEEDED BELOW INVERT IN SUB-SURFACE DETENTION SYSTEM TO PROVIDE 0.1" MINIMUM WATER QUALITY VOLUME STORAGE (0.1" RUNOFF X IMPERVIOUS AREA (Neglecting ROOF AREA))

CALCULATION

TOTAL IMPERVIOUS AREA = 331,056 SF

IMPERVIOUS AREA (-ROOFS) = 237,056 SF

$$\text{SEDIMENT TRAP WQV} = 0.1'' \left(\frac{1'}{12''}\right) \times 237{,}056\ \text{SF}$$

$$= 1{,}975\ \text{CF}$$

∴ DEPTH BELOW INVERT NEEDS TO BE WQV ÷ FOOT PRINT (INTERIOR) OF DETENTION SYSTEM

DEPTH = 1,975 CF ÷ (8' X 816')

Depth = 0.3' PROVIDING 0.5'

Appendix D: Hydrologic/ Hydraulic Analyses

HydroCAD Analysis: Existing Conditions

Worksheet 2: Runoff curve number and runoff

Project 150/200 INNER BELT ROAD By RPM Date 4/21/00

Location SOMERVILLE, MA Checked _____ Date _____

Circle one: (Present) Developed

RAILROAD YARD
FIND CN LOOKING @ 10,000 SF.
PLOT OF "RAIL YARD 8" FROM
THE VAL MAP.

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x area
	Impervious Area (rail, ties)	98			0.07	6.86
	ROCK/BALLAST (TYPE B SOIL - GRAVEL ROAD)	85			0.16	13.60
1/ Use only one CN source per line.				Totals =	0.23	20.46

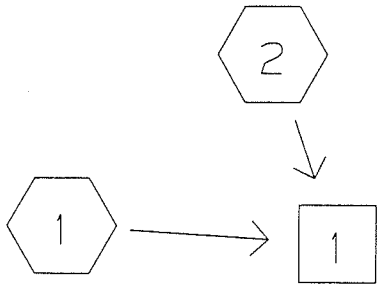
CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{20.46}{0.23} = 88.95$; Use CN = 89

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr	50		
Rainfall, P (24-hour) ..... in	6.0		
Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	4.74		

2-Year Storm Event

WATERSHED ROUTING ==========



SUBCATCHMENT REACH POND LINK

SUBCATCHMENT 1 = EXISTING SHED FLOWING NW TO SE -> REACH 1

SUBCATCHMENT 2 = Partners Property -> REACH 1

REACH 1 = 24" RCP outfall pipe to MBTA Property ->

SUBCATCHMENT 1 **EXISTING SHED FLOWING NW TO SE**

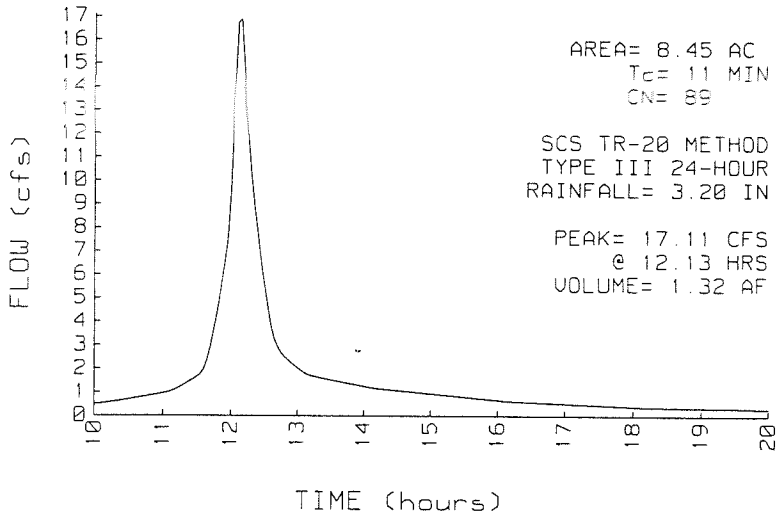
PEAK= 17.11 CFS @ 12.13 HRS, VOLUME= 1.32 AF

ACRES	CN	
8.45	89	EXISTING (OLD RAILROAD YARD)

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 3.20 IN
SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	4.3
Smooth surfaces n=.011 L=300'	P2=3 in s=.008 '/'	
CHANNEL FLOW	**Segment ID:**	6.7
a=1.2 sq-ft Pw=3.8' r=.316'		
s=.005 '/' n=.013 V=3.75 fps	L=1500' Capacity=4.5 cfs	
	Total Length= 1800 ft	Total Tc= 11.0

SUBCATCHMENT 1 RUNOFF
EXISTING SHED FLOWING NW TO SE



SUBCATCHMENT 2 **Partners Property**

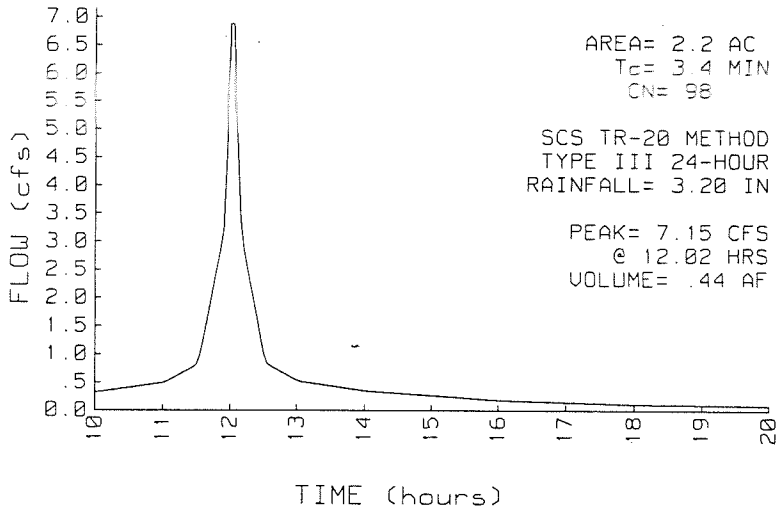
PEAK= 7.15 CFS @ 12.02 HRS, VOLUME= .44 AF

ACRES	CN
2.20	98

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 3.20 IN
SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	2.2
Smooth surfaces n=.011 L=150'	P2=3.2 in s=.01 '/'	
CIRCULAR CHANNEL	**Segment ID:**	1.2
21" Diameter a=2.41 sq-ft Pw=5.5' r=.438'		
s=.001 '/' n=.013 V=2.08 fps L=144'	Capacity=5 cfs	
	Total Length= 294 ft	Total Tc= 3.4

SUBCATCHMENT 2 RUNOFF
Partners Property



REACH 1 **24" RCP outfall pipe to MBTA Property**

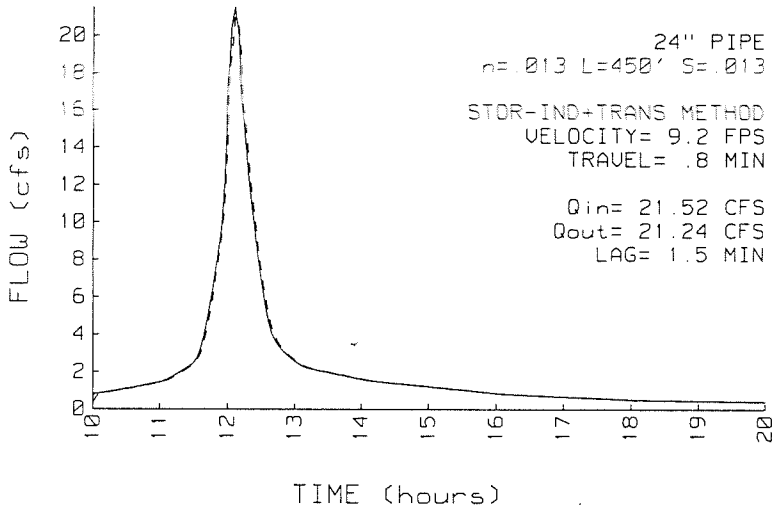
Qin = 21.52 CFS @ 12.10 HRS, VOLUME= 1.77 AF
Qout= 21.24 CFS @ 12.12 HRS, VOLUME= 1.77 AF, ATTEN= 1%, LAG= 1.5 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.20	.16	.54
.40	.45	2.26
.60	.79	5.05
1.40	2.35	21.60
1.60	2.69	25.21
1.80	2.98	27.49
1.88	3.06	27.75
1.94	3.11	27.49
2.00	3.14	25.79

24" PIPE
n= .013
LENGTH= 450 FT
SLOPE= .013 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= 1.39 FT
PEAK VELOCITY= 9.2 FPS
TRAVEL TIME = .8 MIN
SPAN= 10-20 HRS, dt=.05 HRS

REACH 1 INFLOW & OUTFLOW
24" RCP outfall pipe to MBTA Property

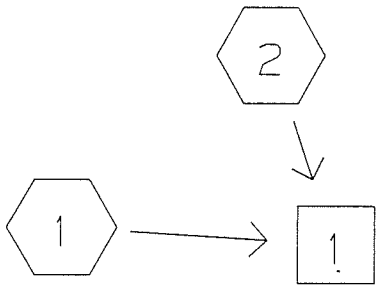


REACH 1 INFLOW PEAK= 21.52 CFS @ 12.10 HOURS

HOUR	0.00	.05	.10	.15	.20	.25	.30	.35	.40	.45
10.00	.81	.83	.86	.88	.91	.94	.97	1.00	1.03	1.06
10.50	1.10	1.13	1.16	1.20	1.23	1.27	1.30	1.34	1.37	1.41
11.00	1.45	1.50	1.57	1.65	1.75	1.86	1.97	2.08	2.20	2.33
11.50	2.46	2.74	3.25	3.96	4.86	5.88	6.98	8.16	9.48	12.11
12.00	16.62	20.41	21.52	20.24	17.51	14.76	12.66	10.98	9.49	8.10
12.50	6.76	5.59	4.68	4.05	3.65	3.38	3.18	3.01	2.85	2.71
13.00	2.57	2.44	2.34	2.26	2.21	2.16	2.12	2.08	2.04	2.01
13.50	1.97	1.93	1.90	1.86	1.83	1.79	1.75	1.72	1.68	1.65
14.00	1.61	1.58	1.55	1.52	1.50	1.48	1.46	1.44	1.43	1.41
14.50	1.39	1.37	1.36	1.34	1.32	1.30	1.29	1.27	1.25	1.23
15.00	1.22	1.20	1.18	1.16	1.15	1.13	1.11	1.09	1.07	1.06
15.50	1.04	1.02	1.00	.99	.97	.95	.93	.91	.90	.88
16.00	.86	.84	.83	.82	.81	.80	.79	.78	.78	.77
16.50	.76	.75	.74	.74	.73	.72	.71	.71	.70	.69
17.00	.68	.67	.67	.66	.65	.64	.64	.63	.62	.61
17.50	.60	.60	.59	.58	.57	.56	.56	.55	.54	.53
18.00	.53	.52	.51	.51	.50	.50	.50	.50	.49	.49
18.50	.49	.49	.48	.48	.48	.48	.48	.47	.47	.47
19.00	.47	.46	.46	.46	.46	.45	.45	.45	.45	.44
19.50	.44	.44	.44	.44	.43	.43	.43	.43	.42	.42
20.00	.42									

10-Year Storm Event

WATERSHED ROUTING ==========



SUBCATCHMENT REACH POND LINK

SUBCATCHMENT 1 = EXISTING SHED FLOWING NW TO SE -> REACH 1

SUBCATCHMENT 2 = Partners Property -> REACH 1

REACH 1 = 24" RCP outfall pipe to MBTA Property ->

SUBCATCHMENT 1 **EXISTING SHED FLOWING NW TO SE**

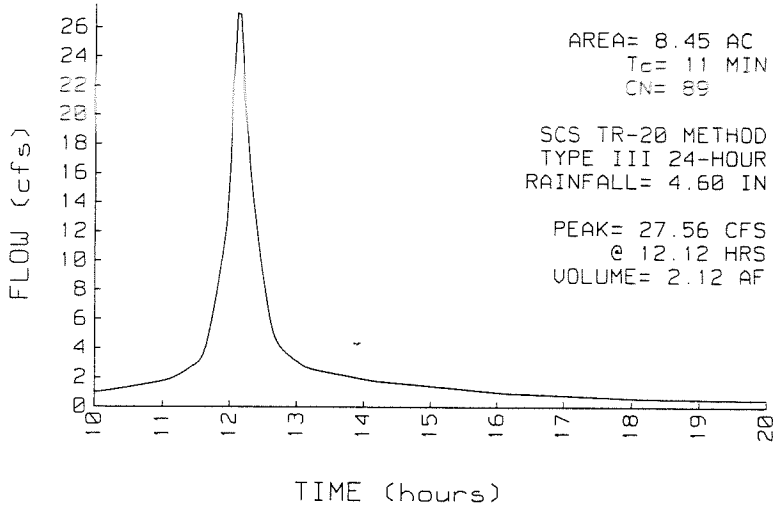
PEAK= 27.56 CFS @ 12.12 HRS, VOLUME= 2.12 AF

ACRES	CN	
8.45	89	EXISTING (OLD RAILROAD YARD)

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 4.60 IN
SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	4.3
Smooth surfaces n=.011 L=300'	P2=3 in s=.008 '/'	
CHANNEL FLOW	**Segment ID:**	6.7
a=1.2 sq-ft Pw=3.8' r=.316'		
s=.005 '/' n=.013 V=3.75 fps	L=1500' Capacity=4.5 cfs	
	Total Length= 1800 ft	Total Tc= 11.0

SUBCATCHMENT 1 RUNOFF
EXISTING SHED FLOWING NW TO SE



SUBCATCHMENT 2 **Partners Property**

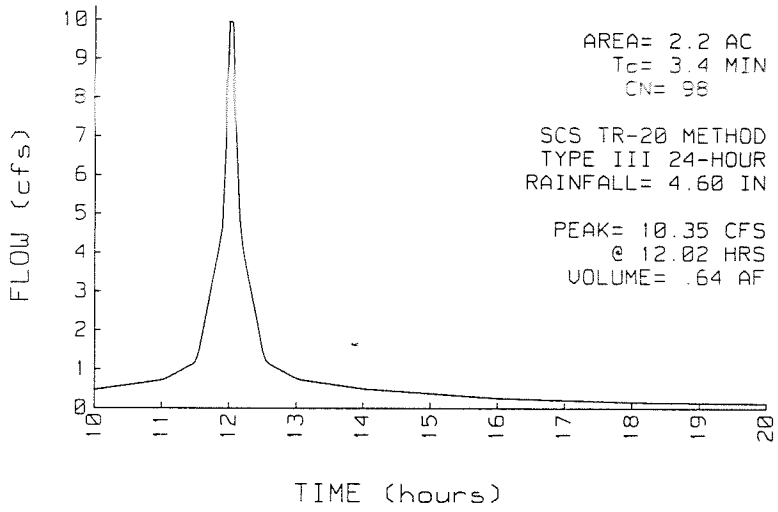
PEAK= 10.35 CFS @ 12.02 HRS, VOLUME= .64 AF

ACRES	CN
2.20	98

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 4.60 IN
SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	2.2
Smooth surfaces n=.011 L=150'	P2=3.2 in s=.01 '/'	
CIRCULAR CHANNEL	**Segment ID:**	1.2
21" Diameter a=2.41 sq-ft Pw=5.5' r=.438'		
s=.001 '/' n=.013 V=2.08 fps L=144'	Capacity=5 cfs	
	Total Length= 294 ft	Total Tc= 3.4

SUBCATCHMENT 2 RUNOFF
Partners Property



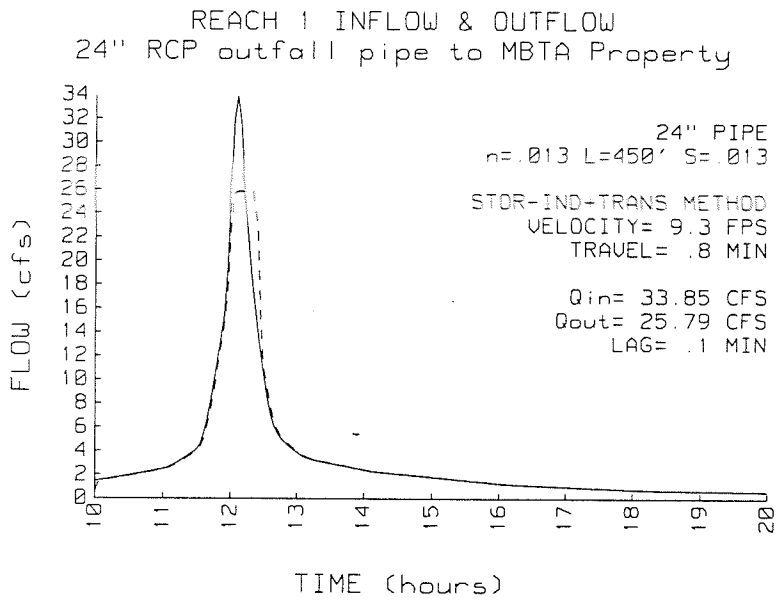
REACH 1 **24" RCP outfall pipe to MBTA Property**

Qin = 33.85 CFS @ 12.10 HRS, VOLUME= 2.76 AF
Qout= 25.79 CFS @ 12.10 HRS, VOLUME= 2.76 AF, ATTEN= 24%, LAG= .1 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.20	.16	.54
.40	.45	2.26
.60	.79	5.05
1.40	2.35	21.60
1.60	2.69	25.21
1.80	2.98	27.49
1.88	3.06	27.75
1.94	3.11	27.49
2.00	3.14	25.79

24" PIPE
n= .013
LENGTH= 450 FT
SLOPE= .013 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= 2.00 FT
PEAK VELOCITY= 9.3 FPS
TRAVEL TIME = .8 MIN
SPAN= 10-20 HRS, dt=.05 HRS

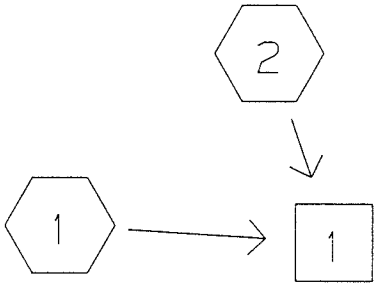


REACH 1 INFLOW PEAK= 33.85 CFS @ 12.10 HOURS

HOUR	0.00	.05	.10	.15	.20	.25	.30	.35	.40	.45
10.00	1.48	1.51	1.55	1.59	1.64	1.69	1.74	1.79	1.84	1.89
10.50	1.94	1.99	2.05	2.10	2.16	2.21	2.27	2.32	2.38	2.44
11.00	2.49	2.57	2.68	2.81	2.97	3.14	3.33	3.51	3.71	3.90
11.50	4.11	4.55	5.33	6.47	7.91	9.55	11.31	13.16	15.21	19.17
12.00	26.00	31.96	33.85	31.80	27.37	22.94	19.57	16.91	14.58	12.42
12.50	10.35	8.54	7.14	6.16	5.55	5.13	4.82	4.56	4.32	4.10
13.00	3.89	3.70	3.54	3.42	3.33	3.26	3.19	3.14	3.08	3.02
13.50	2.97	2.91	2.86	2.80	2.75	2.69	2.64	2.58	2.53	2.47
14.00	2.42	2.37	2.32	2.28	2.25	2.22	2.19	2.17	2.14	2.11
14.50	2.09	2.06	2.03	2.01	1.98	1.95	1.93	1.90	1.88	1.85
15.00	1.82	1.80	1.77	1.74	1.72	1.69	1.66	1.64	1.61	1.58
15.50	1.56	1.53	1.50	1.48	1.45	1.42	1.39	1.37	1.34	1.31
16.00	1.29	1.26	1.24	1.22	1.21	1.19	1.18	1.17	1.16	1.15
16.50	1.13	1.12	1.11	1.10	1.09	1.08	1.06	1.05	1.04	1.03
17.00	1.02	1.01	.99	.98	.97	.96	.95	.94	.92	.91
17.50	.90	.89	.88	.87	.85	.84	.83	.82	.81	.80
18.00	.78	.77	.76	.76	.75	.75	.74	.74	.74	.73
18.50	.73	.73	.72	.72	.71	.71	.71	.70	.70	.70
19.00	.69	.69	.69	.68	.68	.68	.67	.67	.67	.66
19.50	.66	.66	.65	.65	.64	.64	.64	.63	.63	.63
20.00	.62									

100-Year Storm Event

WATERSHED ROUTING ==========



SUBCATCHMENT 1 = EXISTING SHED FLOWING NW TO SE -> REACH 1

SUBCATCHMENT 2 = Partners Property -> REACH 1

REACH 1 = 24" RCP outfall pipe to MBTA Property ->

SUBCATCHMENT 1 **EXISTING SHED FLOWING NW TO SE**

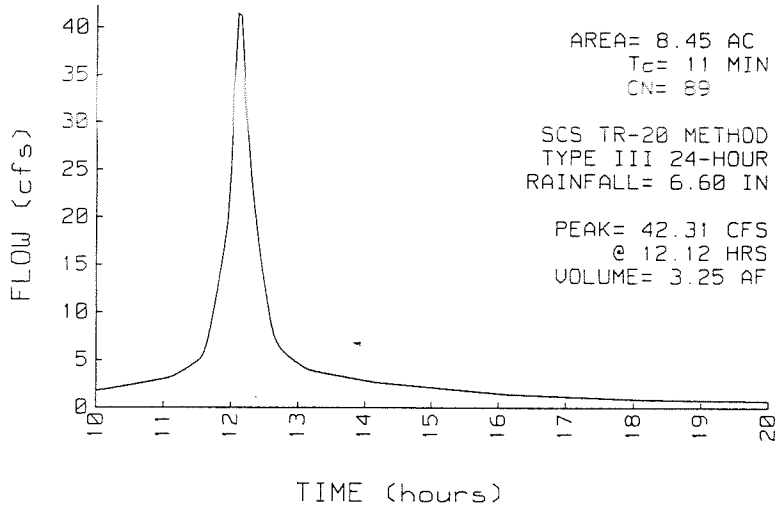
PEAK= 42.31 CFS @ 12.12 HRS, VOLUME= 3.25 AF

ACRES	CN	
8.45	89	EXISTING (OLD RAILROAD YARD)

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 6.60 IN
SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	4.3
Smooth surfaces n=.011 L=300'	P2=3 in s=.008 '/'	
CHANNEL FLOW	**Segment ID:**	6.7
a=1.2 sq-ft Pw=3.8' r=.316'		
s=.005 '/' n=.013 V=3.75 fps	L=1500' Capacity=4.5 cfs	
	Total Length= 1800 ft Total Tc=	11.0

SUBCATCHMENT 1 RUNOFF
EXISTING SHED FLOWING NW TO SE



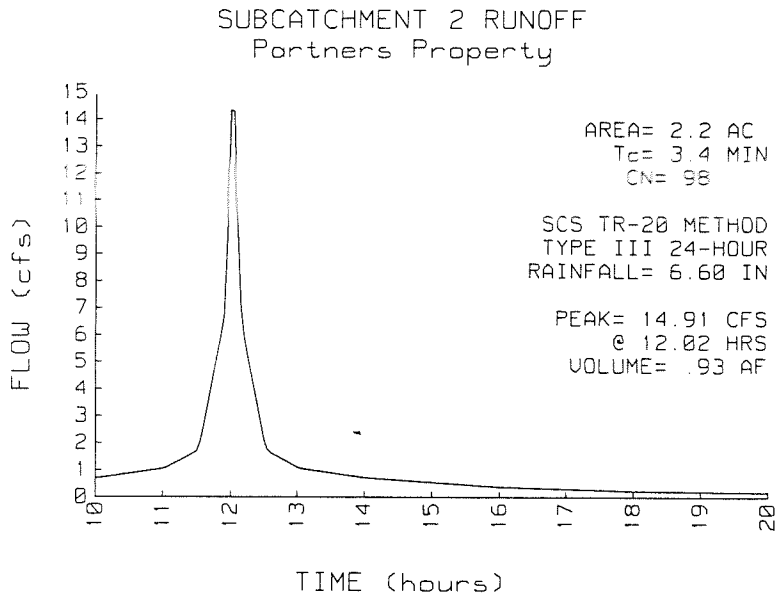
SUBCATCHMENT 2 **Partners Property**

PEAK= 14.91 CFS @ 12.02 HRS, VOLUME= .93 AF

ACRES	CN
2.20	98

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 6.60 IN
SPAN= 10-20 HRS, dt=.05 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	2.2
Smooth surfaces n=.011 L=150' P2=3.2 in s=.01 '/'		
CIRCULAR CHANNEL	**Segment ID:**	1.2
21" Diameter a=2.41 sq-ft Pw=5.5' r=.438'		
s=.001 '/' n=.013 V=2.08 fps L=144' Capacity=5 cfs		
	Total Length= 294 ft Total Tc=	3.4



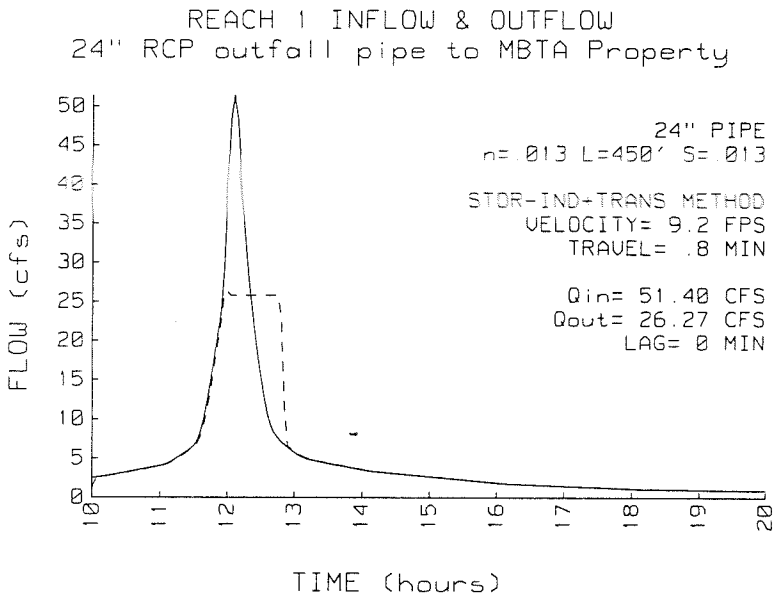
REACH 1 **24" RCP outfall pipe to MBTA Property**

Qin = 51.40 CFS @ 12.10 HRS, VOLUME= 4.18 AF
Qout= 26.27 CFS @ 11.98 HRS, VOLUME= 4.18 AF, ATTEN= 49%, LAG= 0.0 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.20	.16	.54
.40	.45	2.26
.60	.79	5.05
1.40	2.35	21.60
1.60	2.69	25.21
1.80	2.98	27.49
1.88	3.06	27.75
1.94	3.11	27.49
2.00	3.14	25.79

24" PIPE
n= .013
LENGTH= 450 FT
SLOPE= .013 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= 2.00 FT
PEAK VELOCITY= 9.2 FPS
TRAVEL TIME = .8 MIN
SPAN= 10-20 HRS, dt=.05 HRS



REACH 1 INFLOW PEAK= 51.40 CFS @ 12.10 HOURS

HOUR	0.00	.05	.10	.15	.20	.25	.30	.35	.40	.45
10.00	2.51	2.56	2.62	2.68	2.75	2.82	2.90	2.98	3.06	3.14
10.50	3.22	3.30	3.38	3.46	3.55	3.63	3.71	3.80	3.88	3.97
11.00	4.05	4.17	4.33	4.53	4.78	5.05	5.33	5.62	5.91	6.21
11.50	6.54	7.19	8.37	10.11	12.34	14.86	17.56	20.38	23.45	29.29
12.00	39.41	48.44	51.40	48.22	41.34	34.52	29.37	25.30	21.78	18.53
12.50	15.43	12.72	10.61	9.15	8.23	7.61	7.14	6.75	6.40	6.07
13.00	5.75	5.46	5.23	5.05	4.92	4.81	4.72	4.63	4.54	4.46
13.50	4.38	4.30	4.22	4.13	4.05	3.97	3.89	3.81	3.73	3.64
14.00	3.56	3.49	3.42	3.36	3.31	3.27	3.23	3.19	3.15	3.11
14.50	3.07	3.03	2.99	2.95	2.91	2.87	2.84	2.80	2.76	2.72
15.00	2.68	2.64	2.60	2.56	2.52	2.48	2.44	2.40	2.36	2.32
15.50	2.28	2.24	2.21	2.17	2.13	2.09	2.05	2.01	1.97	1.93
16.00	1.89	1.85	1.82	1.79	1.77	1.75	1.73	1.72	1.70	1.68
16.50	1.66	1.65	1.63	1.61	1.60	1.58	1.56	1.54	1.53	1.51
17.00	1.49	1.48	1.46	1.44	1.42	1.41	1.39	1.37	1.35	1.34
17.50	1.32	1.30	1.29	1.27	1.25	1.23	1.22	1.20	1.18	1.17
18.00	1.15	1.13	1.12	1.11	1.10	1.09	1.09	1.08	1.08	1.07
18.50	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.03	1.03	1.02
19.00	1.02	1.01	1.01	1.00	1.00	.99	.98	.98	.97	.97
19.50	.96	.96	.95	.95	.94	.94	.93	.93	.92	.92
20.00	.91									

HydroCAD Analysis: Proposed Conditions

Worksheet 2: Runoff curve number and runoff

Project 150/200 INNER BELT ROAD By RAM Date 4/21/00

Location SOMERVILLE, MA Checked ____ Date ____

Circle one: Present (Developed)

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☒ acres ☐ mi² ☐ %	Product of CN x area
	LANDSCAPED AREAS (USE B TYPE SOIL GOOD CONDITION)	61			0.845	51.45
	IMPERVIOUS AREAS (PAVING & ROOF)	98			7.605	745.29
					Totals =	796.74

1/ Use only one CN source per line.

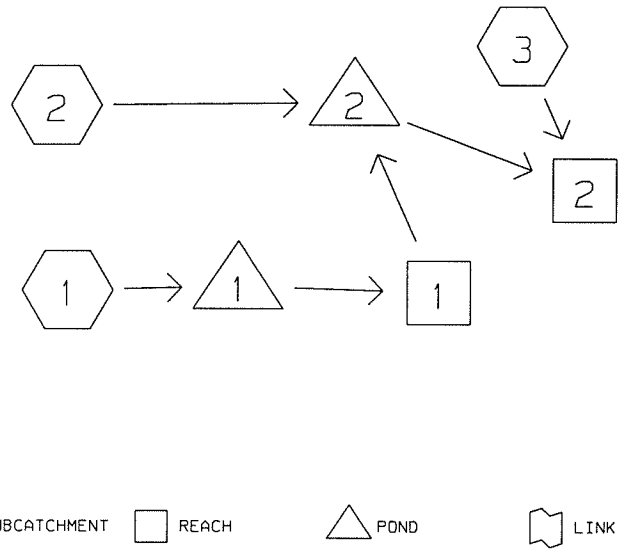
CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{796.74}{8.45} = 94.28$; Use CN = 94

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr	50		
Rainfall, P (24-hour) ..... in	6		
Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	5.3		

2-Year Storm Event

WATERSHED ROUTING ==========



SUBCATCHMENT 1	= SUBCATCHMENT TO INFILTRATION SYSTEM	->	POND 1
SUBCATCHMENT 2	= Site Routing	->	POND 2
SUBCATCHMENT 3	= Partners Property	->	REACH 2
REACH 1	= PIPE RUN FROM INFILTRATION TO POND	->	POND 2
REACH 2	=	->	
POND 1	= INFILTRATION SYSTEM	->	REACH 1
POND 2	= Pond Volume (848 ft of 4x8 Box Culverts)	->	REACH 2

SUBCATCHMENT 1 **SUBCATCHMENT TO INFILTRATION SYSTEM**

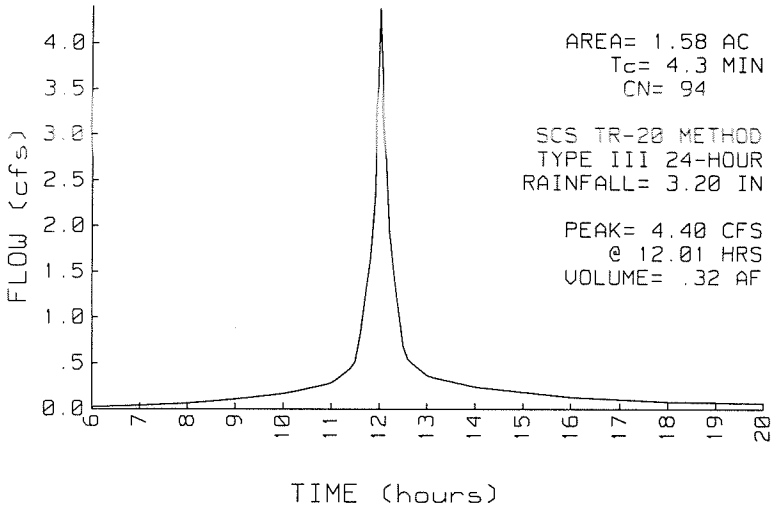
PEAK= 4.40 CFS @ 12.01 HRS, VOLUME= .32 AF

ACRES	CN	
1.58	94	PARKING LOT DRAINAGE

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 3.20 IN
SPAN= 6-20 HRS, dt=.1 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	2.5
Smooth surfaces n=.011 L=250'	P2=3.2 in s=.02 '/'	
SHALLOW CONCENTRATED/UPLAND FLOW	**Segment ID:**	1.8
Paved Kv=20.3282 L=310' s=.02 '/'	V=2.87 fps	
	Total Length= 560 ft Total Tc=	4.3

SUBCATCHMENT 1 RUNOFF
SUBCATCHMENT TO INFILTRATION SYSTEM



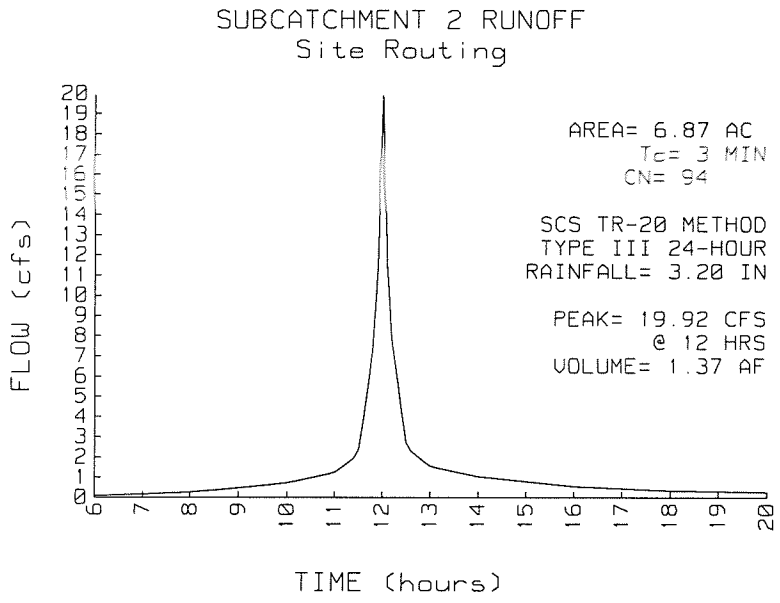
SUBCATCHMENT 2 **Site Routing**

PEAK= 19.92 CFS @ 12.00 HRS, VOLUME= 1.37 AF

ACRES	CN	
6.87	94	REMAINDER OF SITE

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 3.20 IN
SPAN= 6-20 HRS, dt=.1 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	1.1
Smooth surfaces n=.011 L=85' P2=3.2 in s=.02 '/'		
CIRCULAR CHANNEL	**Segment ID:**	1.9
24" Diameter a=3.14 sq-ft Pw=6.3' r=.5'		
s=.005 '/' n=.013 V=5.09 fps L=575' Capacity=16 cfs		
	Total Length= 660 ft Total Tc=	3.0



SUBCATCHMENT 3 **Partners Property**

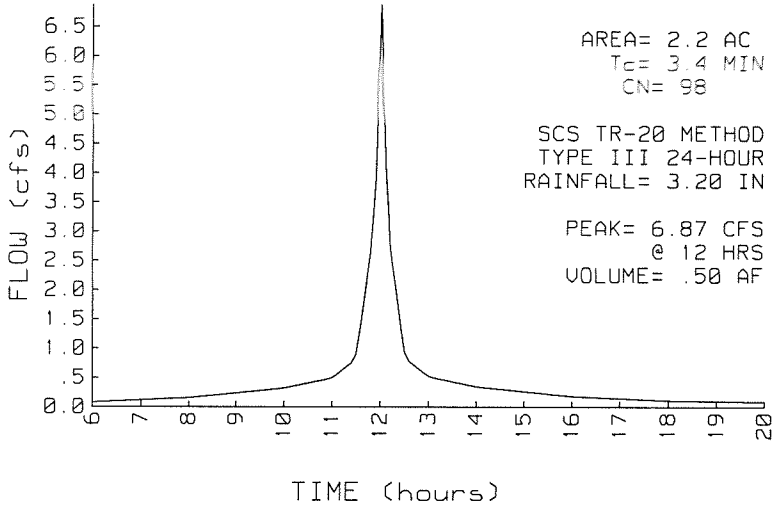
PEAK= 6.87 CFS @ 12.00 HRS, VOLUME= .50 AF

ACRES	CN
2.20	98

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 3.20 IN
SPAN= 6-20 HRS, dt=.1 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	2.2
Smooth surfaces n=.011 L=150' P2=3.2 in s=.01 '/'		
CIRCULAR CHANNEL	**Segment ID:**	1.2
21" Diameter a=2.41 sq-ft Pw=5.5' r=.438'		
s=.001 '/' n=.013 V=2.08 fps L=144' Capacity=5 cfs		
	Total Length= 294 ft Total Tc=	3.4

SUBCATCHMENT 3 RUNOFF
Partners Property



REACH 1 **PIPE RUN FROM INFILTRATION TO POND**

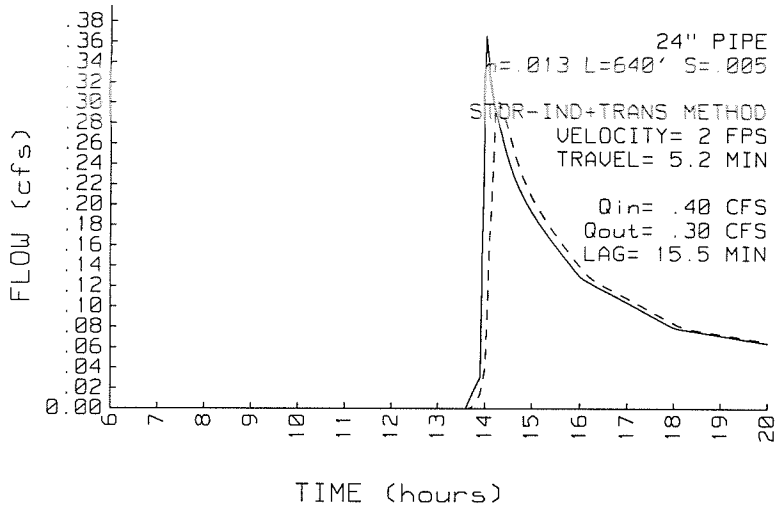
Qin = .40 CFS @ 14.04 HRS, VOLUME= .07 AF
Qout= .30 CFS @ 14.30 HRS, VOLUME= .06 AF, ATTEN= 24%, LAG= 15.5 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.20	.16	.33
.40	.45	1.40
.60	.79	3.13
1.40	2.35	13.39
1.60	2.69	15.64
1.80	2.98	17.05
1.88	3.06	17.21
1.94	3.11	17.05
2.00	3.14	16.00

24" PIPE
n= .013
LENGTH= 640 FT
SLOPE= .005 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= .18 FT
PEAK VELOCITY= 2.0 FPS
TRAVEL TIME = 5.2 MIN
SPAN= 6-20 HRS, dt=.1 HRS
2 x FINER ROUTING

REACH 1 INFLOW & OUTFLOW
PIPE RUN FROM INFILTRATION TO POND



REACH 1 INFLOW PEAK= .40 CFS @ 14.04 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.01	.02	.03
14.00	.37	.33	.30	.27	.26	.24	.23	.22	.21	.20
15.00	.19	.18	.18	.17	.16	.16	.15	.15	.14	.13
16.00	.13	.13	.12	.12	.12	.12	.11	.11	.11	.11
17.00	.10	.10	.10	.10	.09	.09	.09	.09	.08	.08
18.00	.08	.08	.08	.08	.08	.08	.07	.07	.07	.07
19.00	.07	.07	.07	.07	.07	.07	.07	.07	.07	.07
20.00	.06									

REACH 2

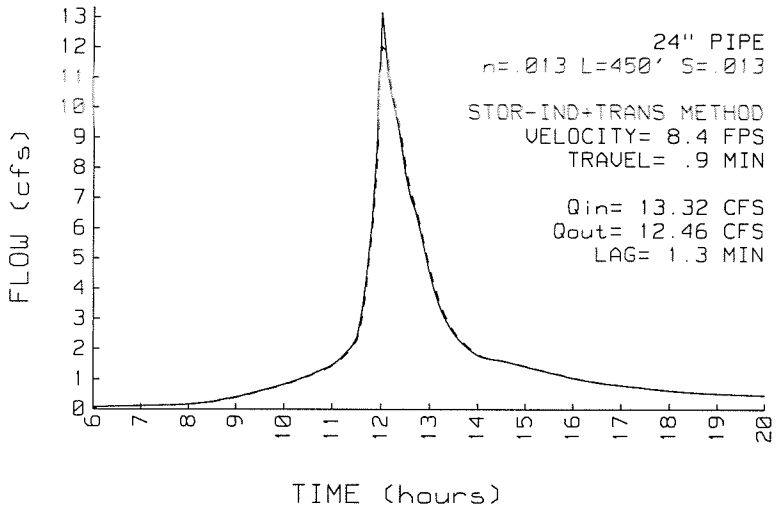
Qin = 13.32 CFS @ 12.02 HRS, VOLUME= 1.87 AF
Qout= 12.46 CFS @ 12.05 HRS, VOLUME= 1.87 AF, ATTEN= 6%, LAG= 1.3 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.20	.16	.54
.40	.45	2.26
.60	.79	5.05
1.40	2.35	21.60
1.60	2.69	25.21
1.80	2.98	27.49
1.88	3.06	27.75
1.94	3.11	27.49
2.00	3.14	25.79

24" PIPE
n= .013
LENGTH= 450 FT
SLOPE= .013 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= .97 FT
PEAK VELOCITY= 8.4 FPS
TRAVEL TIME = .9 MIN
SPAN= 6-20 HRS, dt=.1 HRS
2 x FINER ROUTING

REACH 2 INFLOW & OUTFLOW



REACH 2 INFLOW PEAK= 13.32 CFS @ 12.02 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
6.00	.08	.09	.09	.09	.10	.10	.10	.11	.11	.11
7.00	.12	.12	.13	.13	.13	.14	.14	.15	.15	.16
8.00	.17	.19	.20	.22	.23	.26	.29	.32	.35	.38
9.00	.41	.45	.49	.53	.57	.62	.66	.69	.74	.78
10.00	.83	.88	.94	.99	1.05	1.11	1.18	1.25	1.32	1.38
11.00	1.46	1.58	1.73	1.91	2.10	2.40	3.26	4.51	6.06	8.71
12.00	13.15	11.60	10.63	9.82	8.79	7.75	7.00	6.55	5.92	5.21
13.00	4.48	3.88	3.42	3.05	2.75	2.52	2.32	2.16	2.02	1.89
14.00	1.79	1.72	1.68	1.66	1.64	1.61	1.57	1.54	1.50	1.46
15.00	1.42	1.38	1.34	1.30	1.26	1.22	1.19	1.15	1.11	1.07
16.00	1.04	1.00	.97	.95	.92	.90	.87	.85	.83	.82
17.00	.80	.78	.76	.74	.73	.71	.69	.68	.66	.64
18.00	.62	.61	.60	.59	.58	.57	.56	.55	.54	.53
19.00	.52	.52	.51	.51	.50	.50	.49	.49	.48	.47
20.00	.47									

POND 1 **INFILTRATION SYSTEM**

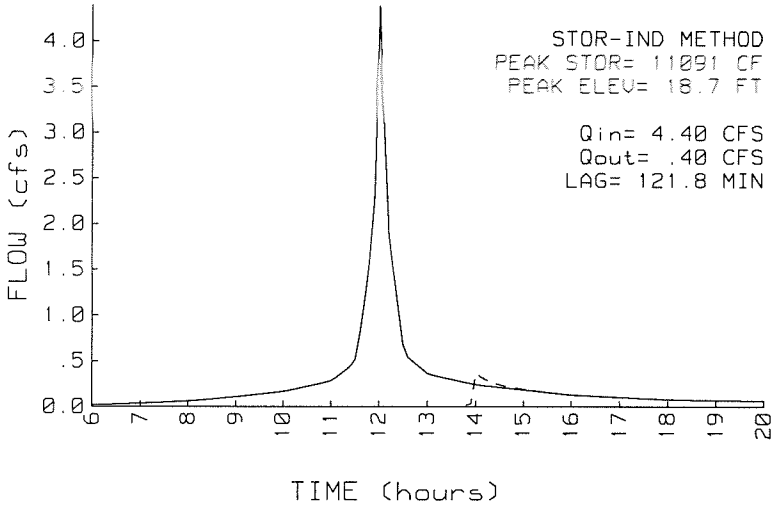
Qin = 4.40 CFS @ 12.01 HRS, VOLUME= .32 AF
Qout= .40 CFS @ 14.04 HRS, VOLUME= .07 AF, ATTEN= 91%, LAG= 121.8 MIN

ELEVATION (FT)	INC.STOR (CF)	CUM.STOR (CF)
15.0	0	0
18.5	11088	11088
19.0	6	11094
20.0	13	11107
21.0	13	11119

STOR-IND METHOD
PEAK STORAGE = 11091 CF
PEAK ELEVATION= 18.7 FT
FLOOD ELEVATION= 20.0 FT
START ELEVATION= 15.0 FT
SPAN= 6-20 HRS, dt=.1 HRS
2 x FINER ROUTING
Tdet= 360.8 MIN (.07 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	18.4'	**18" CULVERT**
			n=.013 L=50' S=.005'/' Ke=.5 Cc=.9 Cd=.6

POND 1 INFLOW & OUTFLOW
INFILTRATION SYSTEM



POND 1 INFLOW PEAK= 4.40 CFS @ 12.01 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
6.00	.02	.02	.02	.03	.03	.03	.03	.03	.03	.04
7.00	.04	.04	.04	.05	.05	.05	.05	.05	.06	.06
8.00	.06	.07	.07	.07	.08	.08	.09	.09	.10	.10
9.00	.11	.11	.12	.13	.13	.14	.14	.15	.15	.16
10.00	.17	.18	.19	.20	.21	.22	.23	.25	.26	.27
11.00	.28	.32	.36	.40	.44	.52	.81	1.20	1.61	2.33
12.00	4.38	3.02	1.92	1.48	1.07	.68	.54	.49	.45	.41
13.00	.36	.35	.33	.32	.31	.30	.29	.28	.26	.25
14.00	.24	.23	.23	.22	.22	.21	.21	.20	.20	.19
15.00	.18	.18	.17	.17	.16	.16	.15	.15	.14	.13
16.00	.13	.13	.12	.12	.12	.12	.11	.11	.11	.11
17.00	.10	.10	.10	.10	.09	.09	.09	.09	.08	.08
18.00	.08	.08	.08	.08	.08	.08	.07	.07	.07	.07
19.00	.07	.07	.07	.07	.07	.07	.07	.07	.07	.07
20.00	.06									

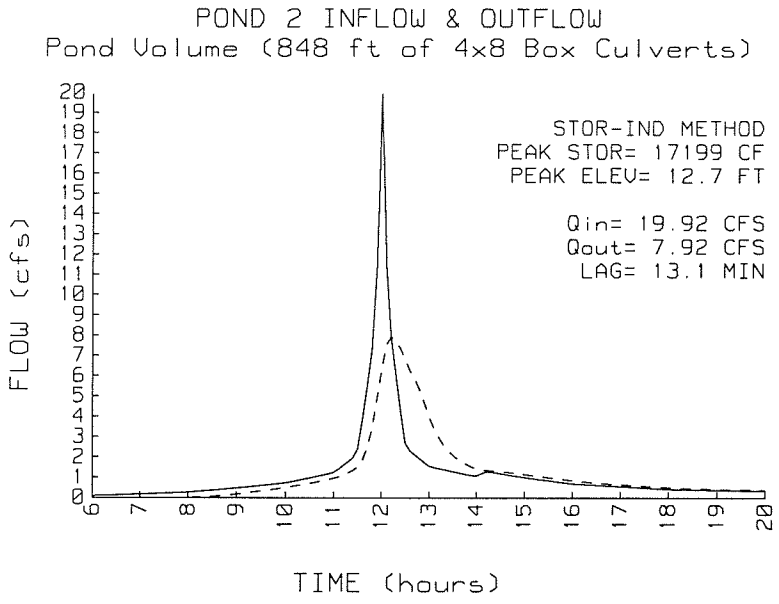
POND 2 **Pond Volume (848 ft of 4x8 Box Culverts)**

Qin = 19.92 CFS @ 12.00 HRS, VOLUME= 1.44 AF
Qout= 7.92 CFS @ 12.22 HRS, VOLUME= 1.37 AF, ATTEN= 60%, LAG= 13.1 MIN

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
10.0	0	0	0
10.3	6784	1018	1018
11.0	6784	4749	5766
12.0	6784	6784	12550
13.0	6784	6784	19334
14.0	6784	6784	26118
15.0	13	3398	29517
16.0	13	13	29529
17.0	13	13	29542
18.0	13	13	29554
19.0	3400	1706	31261

STOR-IND METHOD
PEAK STORAGE = 17199 CF
PEAK ELEVATION= 12.7 FT
FLOOD ELEVATION= 19.0 FT
START ELEVATION= 10.0 FT
SPAN= 6-20 HRS, dt=.1 HRS
2 x FINER ROUTING
Tdet= 55 MIN (1.37 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	10.3'	**15" CULVERT** n=.013 L=50' S=.01'/' Ke=.5 Cc=.9 Cd=.6
2	P	12.5'	**18" CULVERT** n=.013 L=50' S=.01'/' Ke=.5 Cc=.9 Cd=.6

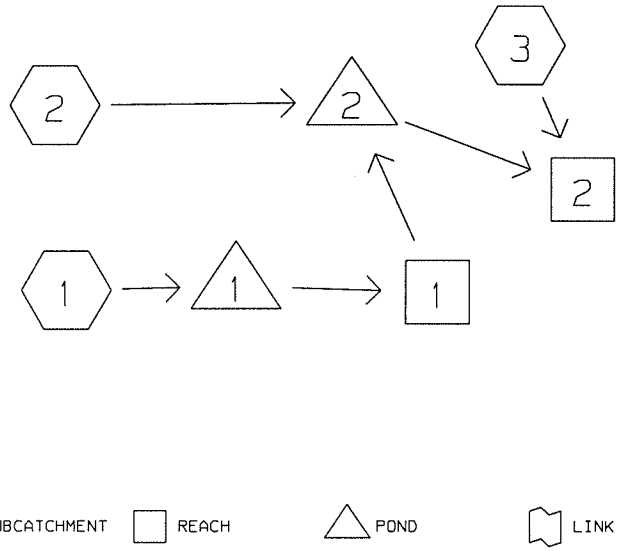


POND 2 INFLOW PEAK= 19.92 CFS @ 12.00 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
6.00	.09	.10	.11	.11	.12	.13	.14	.14	.15	.16
7.00	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26
8.00	.27	.29	.31	.33	.35	.37	.39	.41	.43	.45
9.00	.48	.50	.52	.55	.57	.60	.63	.65	.68	.70
10.00	.73	.78	.83	.87	.92	.97	1.02	1.08	1.13	1.18
11.00	1.26	1.41	1.59	1.77	1.95	2.38	3.84	5.56	7.37	11.42
12.00	19.92	11.34	7.89	6.08	4.27	2.71	2.30	2.11	1.92	1.73
13.00	1.56	1.49	1.44	1.39	1.34	1.29	1.24	1.19	1.14	1.10
14.00	1.08	1.19	1.28	1.27	1.23	1.19	1.15	1.11	1.07	1.04
15.00	1.00	.97	.94	.91	.88	.85	.82	.78	.75	.72
16.00	.70	.68	.66	.65	.64	.62	.61	.60	.58	.57
17.00	.56	.54	.53	.52	.50	.49	.48	.47	.45	.44
18.00	.43	.42	.42	.41	.41	.40	.40	.40	.39	.39
19.00	.38	.38	.38	.37	.37	.36	.36	.36	.35	.35
20.00	.34									

10-Year Storm Event

WATERSHED ROUTING ==========



SUBCATCHMENT 1	= SUBCATCHMENT TO INFILTRATION SYSTEM	->	POND 1
SUBCATCHMENT 2	= Site Routing	->	POND 2
SUBCATCHMENT 3	= Partners Property	->	REACH 2
REACH 1	= PIPE RUN FROM INFILTRATION TO POND	->	POND 2
REACH 2	=	->	
POND 1	= INFILTRATION SYSTEM	->	REACH 1
POND 2	= Pond Volume (848 ft of 4x8 Box Culverts)	->	REACH 2

SUBCATCHMENT 1 **SUBCATCHMENT TO INFILTRATION SYSTEM**

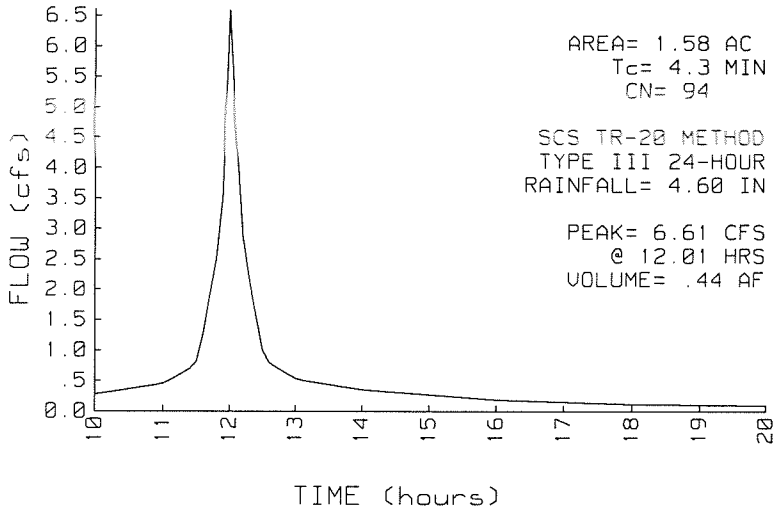
PEAK= 6.61 CFS @ 12.01 HRS, VOLUME= .44 AF

ACRES	CN	
1.58	94	PARKING LOT DRAINAGE

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 4.60 IN
SPAN= 10-20 HRS, dt=.1 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	2.5
Smooth surfaces n=.011 L=250'	P2=3.2 in s=.02 '/'	
SHALLOW CONCENTRATED/UPLAND FLOW	**Segment ID:**	1.8
Paved Kv=20.3282 L=310' s=.02 '/'	V=2.87 fps	
	Total Length= 560 ft Total Tc=	4.3

SUBCATCHMENT 1 RUNOFF
SUBCATCHMENT TO INFILTRATION SYSTEM



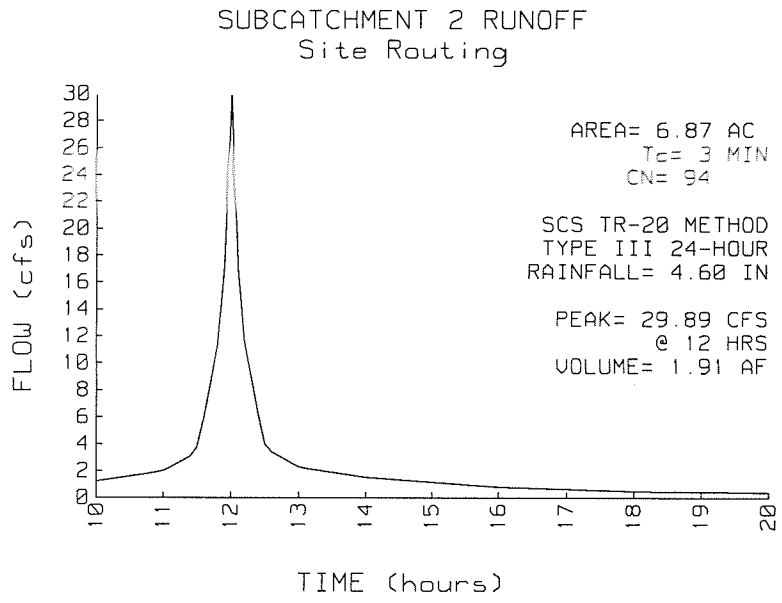
SUBCATCHMENT 2 **Site Routing**

PEAK= 29.89 CFS @ 12.00 HRS, VOLUME= 1.91 AF

ACRES	CN	
6.87	94	REMAINDER OF SITE

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 4.60 IN
SPAN= 10-20 HRS, dt=.1 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	1.1
Smooth surfaces n=.011 L=85' P2=3.2 in s=.02 '/'		
CIRCULAR CHANNEL	**Segment ID:**	1.9
24" Diameter a=3.14 sq-ft Pw=6.3' r=.5'		
s=.005 '/' n=.013 V=5.09 fps L=575' Capacity=16 cfs		
	Total Length= 660 ft Total Tc=	3.0



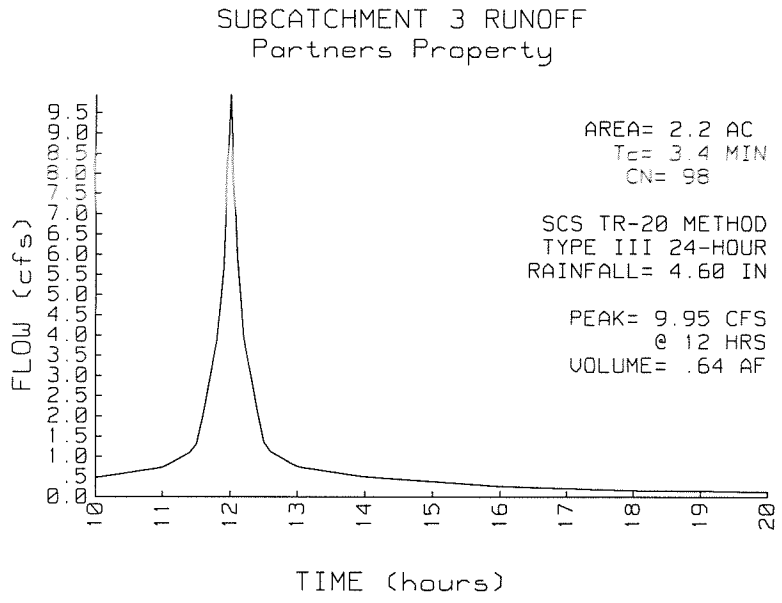
SUBCATCHMENT 3 **Partners Property**

PEAK= 9.95 CFS @ 12.00 HRS, VOLUME= .64 AF

ACRES	CN
2.20	98

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 4.60 IN
SPAN= 10-20 HRS, dt=.1 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	2.2
Smooth surfaces n=.011 L=150' P2=3.2 in s=.01 '/'		
CIRCULAR CHANNEL	**Segment ID:**	1.2
21" Diameter a=2.41 sq-ft Pw=5.5' r=.438'		
s=.001 '/' n=.013 V=2.08 fps L=144' Capacity=5 cfs		
	Total Length= 294 ft Total Tc=	3.4



REACH 1 **PIPE RUN FROM INFILTRATION TO POND**

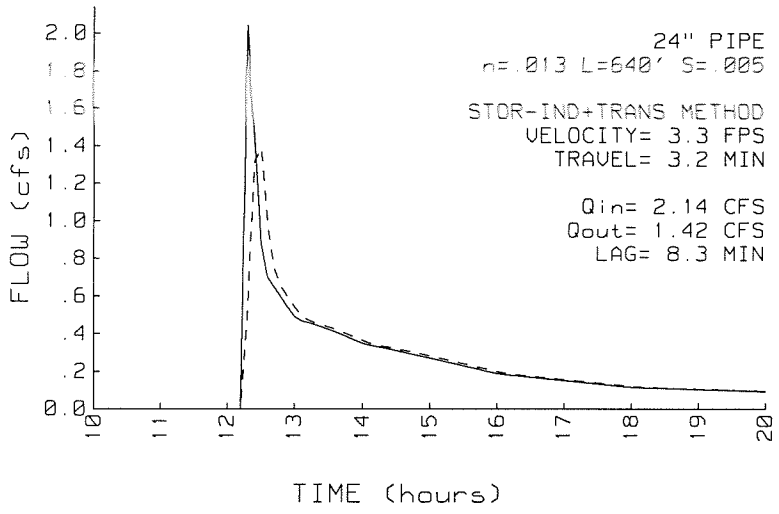
Qin = 2.14 CFS @ 12.33 HRS, VOLUME= .18 AF
Qout= 1.42 CFS @ 12.46 HRS, VOLUME= .18 AF, ATTEN= 34%, LAG= 8.3 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.20	.16	.33
.40	.45	1.40
.60	.79	3.13
1.40	2.35	13.39
1.60	2.69	15.64
1.80	2.98	17.05
1.88	3.06	17.21
1.94	3.11	17.05
2.00	3.14	16.00

24" PIPE
n= .013
LENGTH= 640 FT
SLOPE= .005 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= .42 FT
PEAK VELOCITY= 3.3 FPS
TRAVEL TIME = 3.2 MIN
SPAN= 10-20 HRS, dt=.1 HRS
2 x FINER ROUTING

REACH 1 INFLOW & OUTFLOW
PIPE RUN FROM INFILTRATION TO POND



REACH 1 INFLOW PEAK= 2.14 CFS @ 12.33 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.00	0.00	0.00	0.00	2.04	1.44	.89	.70	.65	.59	.54
13.00	.49	.47	.46	.45	.44	.42	.41	.39	.38	.36
14.00	.35	.34	.33	.33	.32	.31	.30	.29	.29	.28
15.00	.27	.26	.25	.25	.24	.23	.22	.21	.20	.20
16.00	.19	.18	.18	.18	.17	.17	.17	.16	.16	.16
17.00	.15	.15	.14	.14	.14	.13	.13	.13	.12	.12
18.00	.12	.11	.11	.11	.11	.11	.11	.11	.11	.11
19.00	.10	.10	.10	.10	.10	.10	.10	.10	.10	.09
20.00	.09									

REACH 2

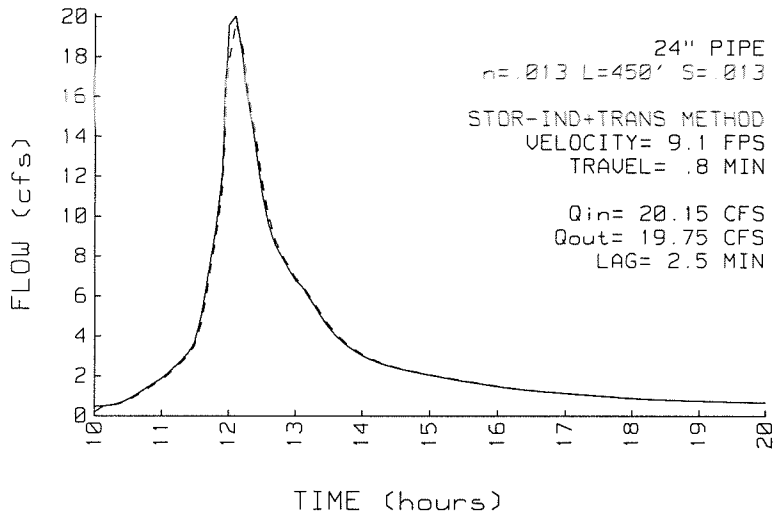
Qin = 20.15 CFS @ 12.07 HRS, VOLUME= 2.65 AF
Qout= 19.75 CFS @ 12.11 HRS, VOLUME= 2.65 AF, ATTEN= 2%, LAG= 2.5 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.20	.16	.54
.40	.45	2.26
.60	.79	5.05
1.40	2.35	21.60
1.60	2.69	25.21
1.80	2.98	27.49
1.88	3.06	27.75
1.94	3.11	27.49
2.00	3.14	25.79

24" PIPE
n= .013
LENGTH= 450 FT
SLOPE= .013 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= 1.32 FT
PEAK VELOCITY= 9.1 FPS
TRAVEL TIME = .8 MIN
SPAN= 10-20 HRS, dt=.1 HRS
2 x FINER ROUTING

REACH 2 INFLOW & OUTFLOW



REACH 2 INFLOW PEAK= 20.15 CFS @ 12.07 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
10.00	.48	.50	.53	.59	.70	.85	1.03	1.24	1.45	1.67
11.00	1.88	2.16	2.46	2.79	3.13	3.65	4.99	6.91	9.05	12.02
12.00	19.59	20.03	18.08	15.88	13.50	11.16	9.58	8.58	7.96	7.37
13.00	6.78	6.49	5.98	5.48	4.93	4.47	4.08	3.75	3.48	3.24
14.00	3.04	2.87	2.73	2.61	2.51	2.42	2.33	2.26	2.19	2.12
15.00	2.05	1.99	1.93	1.87	1.81	1.76	1.70	1.65	1.59	1.54
16.00	1.48	1.43	1.39	1.35	1.31	1.28	1.25	1.22	1.20	1.17
17.00	1.14	1.11	1.09	1.06	1.04	1.01	.99	.96	.94	.91
18.00	.89	.87	.85	.84	.82	.81	.80	.79	.78	.77
19.00	.76	.75	.74	.73	.72	.71	.71	.70	.69	.68
20.00	.67									

POND 1 **INFILTRATION SYSTEM**

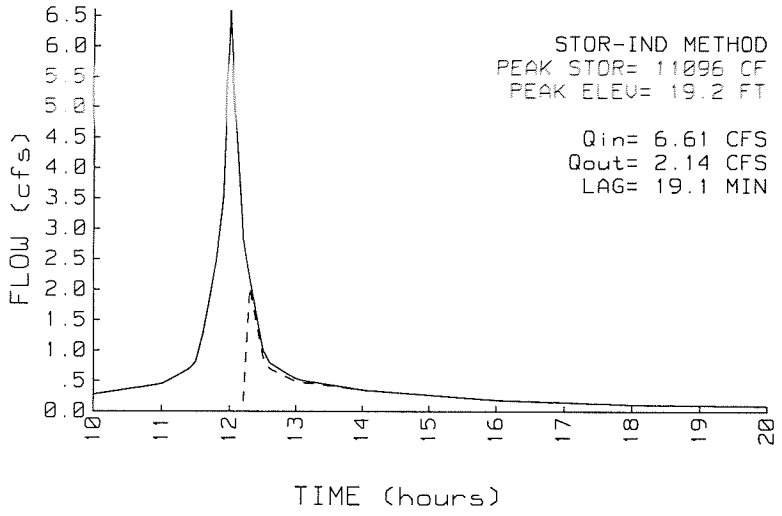
Qin = 6.61 CFS @ 12.01 HRS, VOLUME= .44 AF
Qout= 2.14 CFS @ 12.33 HRS, VOLUME= .18 AF, ATTEN= 68%, LAG= 19.1 MIN

ELEVATION (FT)	INC.STOR (CF)	CUM.STOR (CF)
15.0	0	0
18.5	11088	11088
19.0	6	11094
20.0	13	11107
21.0	13	11119

STOR-IND METHOD
PEAK STORAGE = 11096 CF
PEAK ELEVATION= 19.2 FT
FLOOD ELEVATION= 20.0 FT
START ELEVATION= 15.0 FT
SPAN= 10-20 HRS, dt=.1 HRS
2 x FINER ROUTING
Tdet= 175.8 MIN (.18 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	18.4'	**18" CULVERT**
			n=.013 L=50' S=.005'/' Ke=.5 Cc=.9 Cd=.6

POND 1 INFLOW & OUTFLOW
INFILTRATION SYSTEM



POND 1 INFLOW PEAK= 6.61 CFS @ 12.01 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
10.00	.28	.30	.31	.33	.35	.36	.38	.40	.42	.43
11.00	.46	.51	.57	.63	.70	.81	1.26	1.86	2.47	3.54
12.00	6.59	4.50	2.85	2.19	1.57	1.00	.80	.73	.66	.60
13.00	.54	.51	.49	.47	.46	.44	.42	.40	.39	.37
14.00	.35	.34	.34	.33	.32	.31	.30	.30	.29	.28
15.00	.27	.26	.25	.25	.24	.23	.22	.21	.20	.20
16.00	.19	.18	.18	.18	.17	.17	.17	.16	.16	.16
17.00	.15	.15	.14	.14	.14	.13	.13	.13	.12	.12
18.00	.12	.11	.11	.11	.11	.11	.11	.11	.11	.11
19.00	.10	.10	.10	.10	.10	.10	.10	.10	.10	.09
20.00	.09									

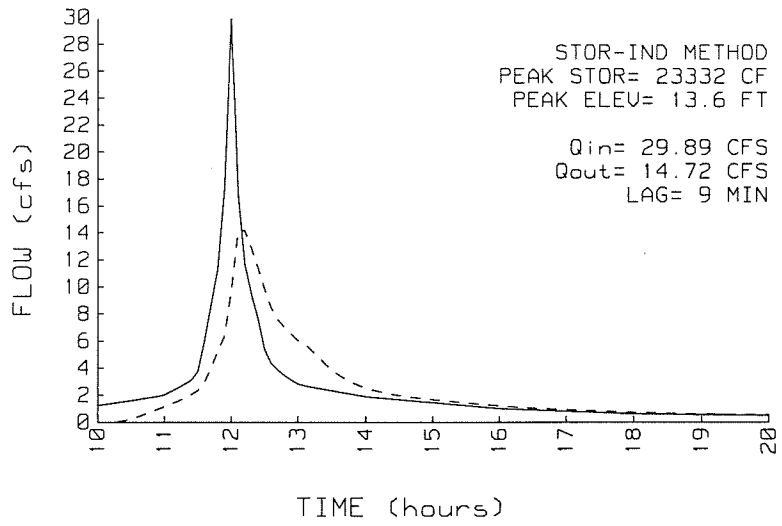
POND 2 **Pond Volume (848 ft of 4x8 Box Culverts)**

Qin = 29.89 CFS @ 12.00 HRS, VOLUME= 2.09 AF
Qout= 14.72 CFS @ 12.15 HRS, VOLUME= 2.01 AF, ATTEN= 51%, LAG= 9.0 MIN

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
10.0	0	0	0
10.3	6784	1018	1018
11.0	6784	4749	5766
12.0	6784	6784	12550
13.0	6784	6784	19334
14.0	6784	6784	26118
15.0	13	3398	29517
16.0	13	13	29529
17.0	13	13	29542
18.0	13	13	29554
19.0	3400	1706	31261

STOR-IND METHOD
PEAK STORAGE = 23332 CF
PEAK ELEVATION= 13.6 FT
FLOOD ELEVATION= 19.0 FT
START ELEVATION= 10.0 FT
SPAN= 10-20 HRS, dt=.1 HRS
2 x FINER ROUTING
Tdet= 42.5 MIN (1.99 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	10.3'	**15" CULVERT** n=.013 L=50' S=.01'/' Ke=.5 Cc=.9 Cd=.6
2	P	12.5'	**18" CULVERT** n=.013 L=50' S=.01'/' Ke=.5 Cc=.9 Cd=.6

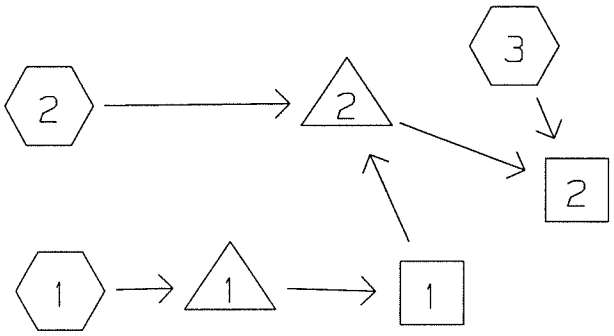


POND 2 INFLOW PEAK= 29.89 CFS @ 12.00 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
10.00	1.23	1.30	1.37	1.45	1.52	1.60	1.67	1.75	1.83	1.91
11.00	2.02	2.26	2.53	2.80	3.08	3.74	5.99	8.61	11.31	17.34
12.00	29.88	16.87	11.69	9.49	7.61	5.38	4.37	3.85	3.48	3.13
13.00	2.83	2.69	2.59	2.50	2.42	2.33	2.24	2.16	2.07	1.98
14.00	1.89	1.84	1.79	1.75	1.71	1.67	1.62	1.58	1.54	1.49
15.00	1.45	1.41	1.36	1.32	1.28	1.23	1.19	1.14	1.10	1.06
16.00	1.01	.99	.97	.95	.93	.91	.89	.87	.85	.83
17.00	.81	.79	.77	.76	.74	.72	.70	.68	.66	.64
18.00	.62	.61	.61	.60	.59	.59	.58	.58	.57	.57
19.00	.56	.55	.55	.54	.54	.53	.53	.52	.51	.51
20.00	.50									

100-Year Storm Event

WATERSHED ROUTING ==========



SUBCATCHMENT 1	= SUBCATCHMENT TO INFILTRATION SYSTEM	->	POND 1
SUBCATCHMENT 2	= Site Routing	->	POND 2
SUBCATCHMENT 3	= Partners Property	->	REACH 2
REACH 1	= PIPE RUN FROM INFILTRATION TO POND	->	POND 2
REACH 2	=	->	
POND 1	= INFILTRATION SYSTEM	->	REACH 1
POND 2	= Pond Volume (848 ft of 4x8 Box Culverts)	->	REACH 2

SUBCATCHMENT 1 **SUBCATCHMENT TO INFILTRATION SYSTEM**

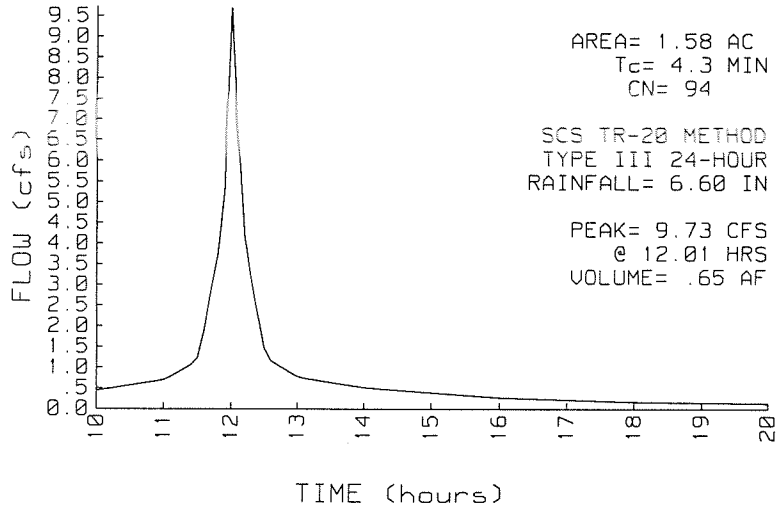
PEAK= 9.73 CFS @ 12.01 HRS, VOLUME= .65 AF

ACRES	CN	
1.58	94	PARKING LOT DRAINAGE

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 6.60 IN
SPAN= 10-20 HRS, dt=.1 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	2.5
Smooth surfaces n=.011 L=250'	P2=3.2 in s=.02 '/'	
SHALLOW CONCENTRATED/UPLAND FLOW	**Segment ID:**	1.8
Paved Kv=20.3282 L=310' s=.02 '/'	V=2.87 fps	
	Total Length= 560 ft Total Tc=	4.3

SUBCATCHMENT 1 RUNOFF
SUBCATCHMENT TO INFILTRATION SYSTEM



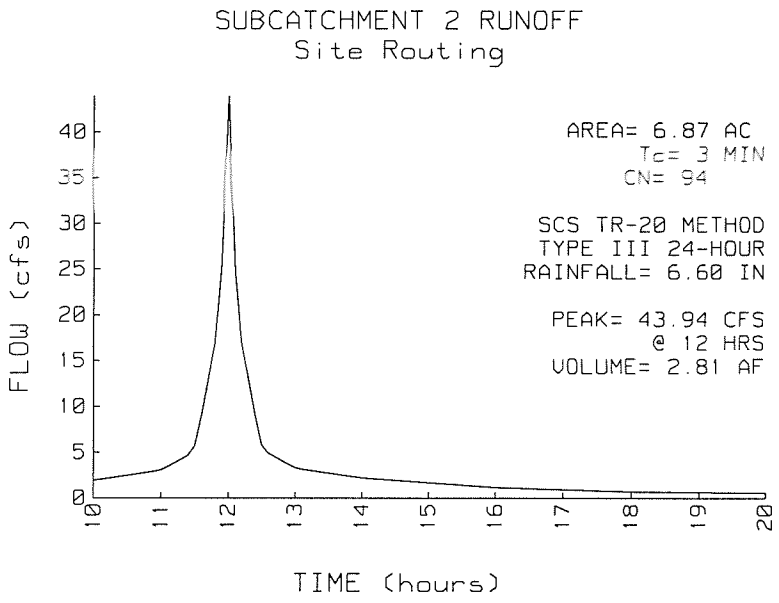
SUBCATCHMENT 2 **Site Routing**

PEAK= 43.94 CFS @ 12.00 HRS, VOLUME= 2.81 AF

ACRES	CN	
6.87	94	REMAINDER OF SITE

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 6.60 IN
SPAN= 10-20 HRS, dt=.1 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	1.1
Smooth surfaces n=.011 L=85' P2=3.2 in s=.02 '/'		
CIRCULAR CHANNEL	**Segment ID:**	1.9
24" Diameter a=3.14 sq-ft Pw=6.3' r=.5'		
s=.005 '/' n=.013 V=5.09 fps L=575' Capacity=16 cfs		
	Total Length= 660 ft Total Tc=	3.0



SUBCATCHMENT 3 **Partners Property**

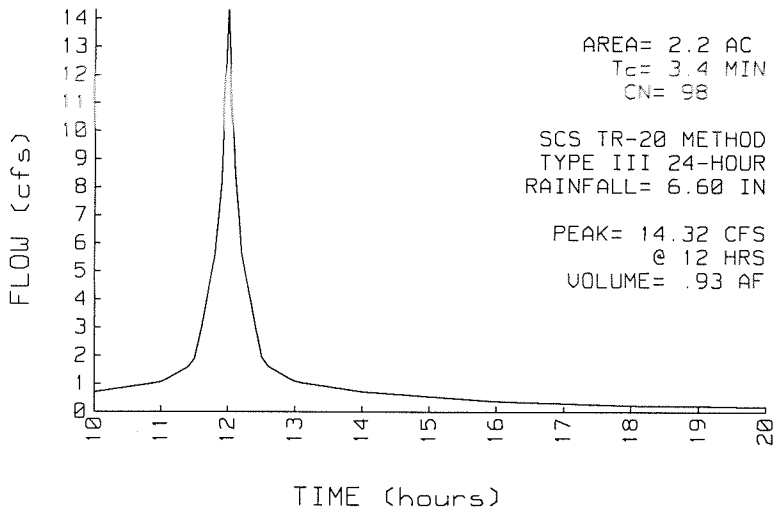
PEAK= 14.32 CFS @ 12.00 HRS, VOLUME= .93 AF

ACRES	CN
2.20	98

SCS TR-20 METHOD
TYPE III 24-HOUR
RAINFALL= 6.60 IN
SPAN= 10-20 HRS, dt=.1 HRS

Method	Comment	Tc (min)
TR-55 SHEET FLOW	**Segment ID:**	2.2
Smooth surfaces n=.011 L=150'	P2=3.2 in s=.01 '/'	
CIRCULAR CHANNEL	**Segment ID:**	1.2
21" Diameter a=2.41 sq-ft Pw=5.5' r=.438'		
s=.001 '/' n=.013 V=2.08 fps L=144'	Capacity=5 cfs	
	Total Length= 294 ft Total Tc=	3.4

SUBCATCHMENT 3 RUNOFF
Partners Property



REACH 1 **PIPE RUN FROM INFILTRATION TO POND**

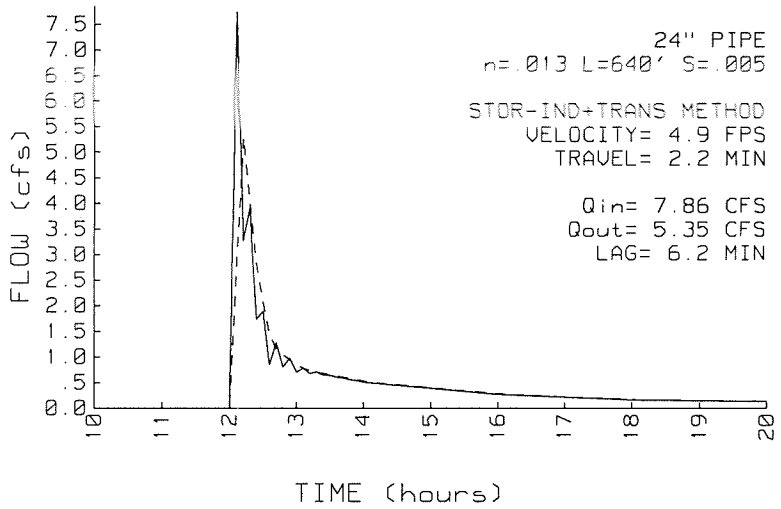
Qin = 7.86 CFS @ 12.11 HRS, VOLUME= .37 AF
Qout= 5.35 CFS @ 12.22 HRS, VOLUME= .37 AF, ATTEN= 32%, LAG= 6.2 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.20	.16	.33
.40	.45	1.40
.60	.79	3.13
1.40	2.35	13.39
1.60	2.69	15.64
1.80	2.98	17.05
1.88	3.06	17.21
1.94	3.11	17.05
2.00	3.14	16.00

24" PIPE
n= .013
LENGTH= 640 FT
SLOPE= .005 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= .81 FT
PEAK VELOCITY= 4.9 FPS
TRAVEL TIME = 2.2 MIN
SPAN= 10-20 HRS, dt=.1 HRS

REACH 1 INFLOW & OUTFLOW
PIPE RUN FROM INFILTRATION TO POND



REACH 1 INFLOW PEAK= 7.86 CFS @ 12.11 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.00	0.00	7.75	3.27	3.92	1.74	1.89	.85	1.28	.81	.98
13.00	.71	.79	.68	.71	.65	.65	.61	.59	.56	.54
14.00	.51	.50	.49	.48	.46	.45	.44	.43	.42	.40
15.00	.39	.38	.37	.36	.34	.33	.32	.31	.30	.28
16.00	.27	.27	.26	.26	.25	.25	.24	.24	.23	.22
17.00	.22	.21	.21	.20	.20	.19	.19	.18	.18	.17
18.00	.17	.17	.16	.16	.16	.16	.16	.16	.15	.15
19.00	.15	.15	.15	.15	.15	.14	.14	.14	.14	.14
20.00	.14									

REACH 2

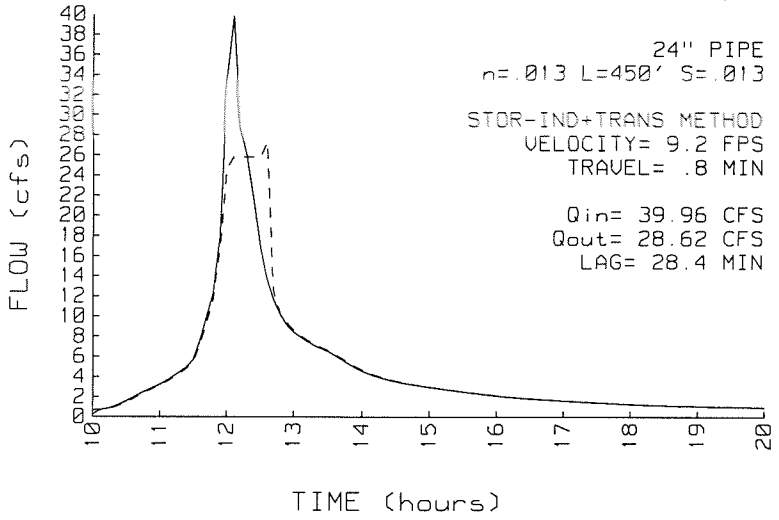
Qin = 39.96 CFS @ 12.09 HRS, VOLUME= 4.02 AF
Qout= 28.62 CFS @ 12.56 HRS, VOLUME= 4.01 AF, ATTEN= 28%, LAG= 28.4 MIN

DEPTH (FT)	END AREA (SQ-FT)	DISCH (CFS)
0.00	0.00	0.00
.20	.16	.54
.40	.45	2.26
.60	.79	5.05
1.40	2.35	21.60
1.60	2.69	25.21
1.80	2.98	27.49
1.88	3.06	27.75
1.94	3.11	27.49
2.00	3.14	25.79

24" PIPE
n= .013
LENGTH= 450 FT
SLOPE= .013 FT/FT

STOR-IND+TRANS METHOD
PEAK DEPTH= 2.00 FT
PEAK VELOCITY= 9.2 FPS
TRAVEL TIME = .8 MIN
SPAN= 10-20 HRS, dt=.1 HRS
2 x FINER ROUTING

REACH 2 INFLOW & OUTFLOW



REACH 2 INFLOW PEAK= 39.96 CFS @ 12.09 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
10.00	.70	.74	.81	1.00	1.29	1.62	1.96	2.31	2.63	2.92
11.00	3.22	3.59	4.01	4.47	4.95	5.67	7.59	9.96	12.35	17.98
12.00	33.60	39.79	28.71	25.86	21.50	17.04	13.87	11.68	10.17	9.11
13.00	8.41	7.93	7.49	7.06	6.79	6.49	6.10	5.72	5.30	4.91
14.00	4.56	4.28	4.04	3.84	3.67	3.52	3.38	3.26	3.15	3.05
15.00	2.95	2.86	2.77	2.68	2.60	2.51	2.43	2.34	2.27	2.19
16.00	2.11	2.04	1.98	1.93	1.87	1.83	1.78	1.74	1.70	1.66
17.00	1.63	1.59	1.55	1.51	1.48	1.44	1.41	1.37	1.33	1.30
18.00	1.27	1.24	1.22	1.20	1.18	1.16	1.14	1.12	1.11	1.09
19.00	1.08	1.07	1.06	1.04	1.03	1.02	1.01	1.00	.99	.97
20.00	.96									

POND 1 **INFILTRATION SYSTEM**

Qin = 9.73 CFS @ 12.01 HRS, VOLUME= .65 AF
Qout= 7.86 CFS @ 12.11 HRS, VOLUME= .37 AF, ATTEN= 19%, LAG= 6.3 MIN

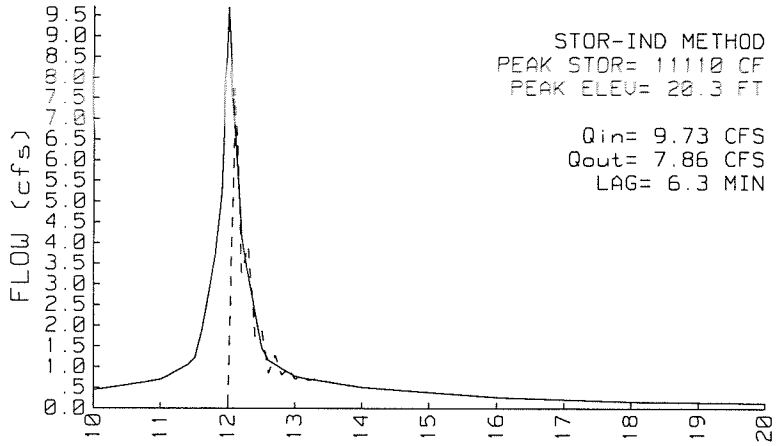
ELEVATION (FT)	INC.STOR (CF)	CUM.STOR (CF)
15.0	0	0
18.5	11088	11088
18.6	1	11089
19.0	5	11094
20.0	13	11107
21.0	13	11119

STOR-IND METHOD
PEAK STORAGE = 11110 CF
PEAK ELEVATION= 20.3 FT
FLOOD ELEVATION= 21.0 FT
START ELEVATION= 15.0 FT
SPAN= 10-20 HRS, dt=.1 HRS
3 x FINER ROUTING
Tdet= 129.8 MIN (.37 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	18.4'	**18" CULVERT**

n=.013 L=50' S=.005'/' Ke=.5 Cc=.9 Cd=.6

POND 1 INFLOW & OUTFLOW
INFILTRATION SYSTEM



POND 1 INFLOW PEAK= 9.73 CFS @ 12.01 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
10.00	.45	.47	.49	.52	.54	.57	.59	.62	.64	.67
11.00	.70	.78	.87	.96	1.06	1.23	1.91	2.79	3.69	5.25
12.00	9.70	6.59	4.16	3.20	2.29	1.46	1.16	1.06	.96	.87
13.00	.78	.74	.71	.69	.66	.64	.61	.59	.56	.54
14.00	.51	.50	.49	.48	.46	.45	.44	.43	.42	.40
15.00	.39	.38	.37	.36	.34	.33	.32	.31	.30	.28
16.00	.27	.27	.26	.26	.25	.25	.24	.24	.23	.22
17.00	.22	.21	.21	.20	.20	.19	.19	.18	.18	.17
18.00	.17	.17	.16	.16	.16	.16	.16	.16	.15	.15
19.00	.15	.15	.15	.15	.15	.14	.14	.14	.14	.14
20.00	.14									

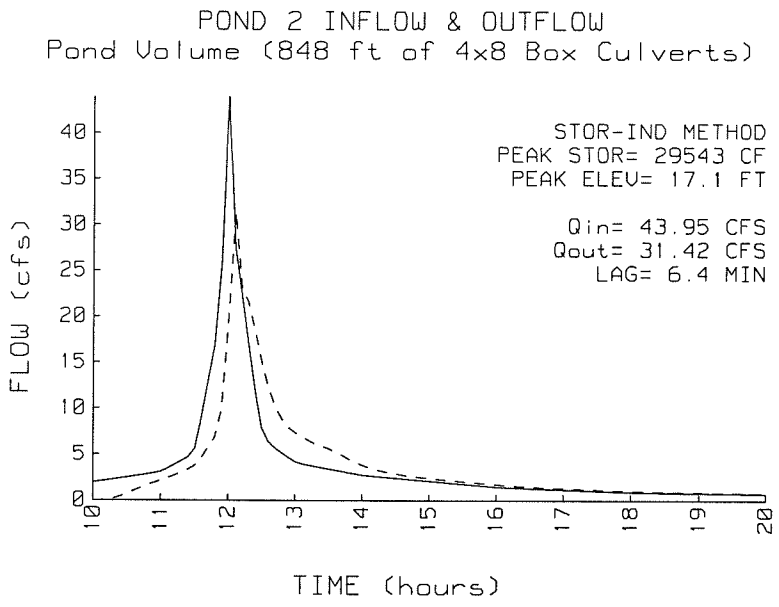
POND 2 **Pond Volume (848 ft of 4x8 Box Culverts)**

Qin = 43.95 CFS @ 12.00 HRS, VOLUME= 3.18 AF
Qout= 31.42 CFS @ 12.11 HRS, VOLUME= 3.09 AF, ATTEN= 29%, LAG= 6.4 MIN

ELEVATION (FT)	AREA (SF)	INC.STOR (CF)	CUM.STOR (CF)
10.0	0	0	0
10.3	6784	1018	1018
11.0	6784	4749	5766
12.0	6784	6784	12550
13.0	6784	6784	19334
14.0	6784	6784	26118
15.0	13	3398	29517
16.0	13	13	29529
17.0	13	13	29542
18.0	13	13	29554
19.0	3400	1706	31261

STOR-IND METHOD
PEAK STORAGE = 29543 CF
PEAK ELEVATION= 17.1 FT
FLOOD ELEVATION= 19.0 FT
START ELEVATION= 10.0 FT
SPAN= 10-20 HRS, dt=.1 HRS
2 x FINER ROUTING
Tdet= 35.2 MIN (3.06 AF)

#	ROUTE	INVERT	OUTLET DEVICES
1	P	10.3'	**15" CULVERT** n=.013 L=50' S=.01'/' Ke=.5 Cc=.9 Cd=.6
2	P	12.5'	**18" CULVERT** n=.013 L=50' S=.01'/' Ke=.5 Cc=.9 Cd=.6



POND 2 INFLOW PEAK= 43.95 CFS @ 12.00 HOURS

HOUR	0.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
10.00	1.96	2.06	2.16	2.27	2.38	2.49	2.60	2.71	2.82	2.94
11.00	3.10	3.46	3.86	4.27	4.68	5.66	9.03	12.91	16.85	25.67
12.00	43.94	27.41	22.35	17.12	12.02	7.88	6.38	5.68	5.15	4.64
13.00	4.19	3.96	3.81	3.67	3.54	3.41	3.28	3.14	3.01	2.88
14.00	2.75	2.67	2.61	2.54	2.48	2.41	2.35	2.29	2.22	2.16
15.00	2.10	2.03	1.97	1.90	1.84	1.78	1.71	1.65	1.59	1.53
16.00	1.47	1.43	1.40	1.37	1.34	1.32	1.29	1.26	1.23	1.20
17.00	1.18	1.15	1.12	1.09	1.06	1.04	1.01	.98	.95	.93
18.00	.90	.89	.88	.87	.86	.85	.84	.84	.83	.82
19.00	.81	.80	.79	.78	.78	.77	.76	.75	.74	.73
20.00	.73									

StormCAD Analysis

Scenario: Base

Pipe Report

Label	Upstream Node	Downstream Node	Area (acres)	Inlet C	Inlet CA (acres)	System Contributing Area (acres)	System Intensity (in/hr)	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade In (ft)	Hydraulic Grade Out (ft)	Description
P1	DCB 1	STC 1	0.931	0.73	0.680	0.680	5.40	3.70	20.00	0.012500	15 inch	0.013	7.22	18.00	17.75	21.00	21.30	1.75	2.30	18.78	18.56	
P2	DCB 2	STC 1	1.390	0.50	0.695	0.695	5.40	3.78	25.00	0.010000	15 inch	0.013	6.46	18.00	17.75	21.00	21.30	1.75	2.30	18.79	18.56	
P3	STC 1	DMH 1				1.375	5.38	7.46	10.00	0.010000	18 inch	0.013	10.50	17.50	17.40	21.30	21.50	2.30	2.60	18.56	18.47	STORMCEPTOR
P4	DMH 1	DMH 2				1.375	5.38	7.45	55.00	0.005455	18 inch	0.013	7.76	17.30	17.00	21.50	21.50	2.70	3.00	18.47	18.11	
P5	DMH 2	DMH 3				1.375	5.34	7.40	80.00	0.005000	18 inch	0.013	7.43	16.90	16.50	21.50	22.00	3.10	4.00	18.11	17.55	
P6	ROOF 1	DMH 3	0.539	0.90	0.485	0.485	5.40	2.64	40.00	0.010000	12 inch	0.013	3.56	17.80	17.40	22.80	22.00	4.00	3.60	18.50	18.04	
P7	DMH 3	DMH 4				1.860	5.29	9.92	105.00	0.005714	24 inch	0.013	17.10	16.40	15.80	22.00	21.20	3.60	3.40	17.53	16.89	
P8	CB 3	DMH 4	0.156	0.90	0.140	0.140	5.40	0.76	5.00	0.020000	12 inch	0.013	5.04	18.00	17.90	21.00	21.20	2.00	2.30	18.37	18.19	
P9	DMH 4	DMH 5				2.000	5.23	10.54	210.00	0.005000	24 inch	0.013	16.00	15.70	14.65	21.20	21.20	3.50	4.55	16.88	15.81	
P10	CB 4	DMH 5	0.154	0.90	0.139	0.139	5.40	0.75	5.00	0.020000	12 inch	0.013	5.04	18.00	17.90	21.00	21.20	2.00	2.30	18.36	18.19	
P11	DMH 5	DMH 6				2.139	5.10	10.99	112.00	0.005804	24 inch	0.013	17.23	14.55	13.90	21.20	21.50	4.65	5.60	15.74	15.30	
P12	ROOF 2	DMH 6	0.539	0.90	0.485	0.485	5.40	2.64	40.00	0.010000	12 inch	0.013	3.56	17.80	17.40	22.80	21.50	4.00	3.10	18.50	18.04	
P13	DMH 6	DMH 7				2.624	5.03	13.29	80.00	0.005000	24 inch	0.013	16.00	13.80	13.40	21.50	19.80	5.70	4.40	15.30	15.10	
P14	DCB 5	DMH 8	0.333	0.65	0.216	0.216	5.40	1.18	145.00	0.014483	12 inch	0.013	4.29	18.10	16.00	21.10	22.20	2.00	5.20	18.56	16.36	
P15	DCB 6	DMH 8	0.523	0.70	0.366	0.366	5.40	1.99	20.00	0.015000	12 inch	0.013	4.36	15.90	15.60	18.50	22.20	1.60	5.60	16.50	16.25	
P16	DMH 8	DMH 9				0.583	5.28	3.10	250.00	0.005200	15 inch	0.013	4.66	15.50	14.20	22.20	22.90	5.45	7.45	16.25	15.36	
P17	DMH 9	DMH 7				0.583	5.03	2.95	125.00	0.004800	15 inch	0.013	4.48	14.10	13.50	22.90	19.80	7.55	5.05	15.36	15.10	
P18	DCB 7	DMH 7	0.390	0.77	0.300	0.300	5.40	1.63	75.00	0.010667	12 inch	0.013	3.68	17.40	16.60	20.40	19.80	2.00	2.20	17.94	17.07	
P19	DCB 8	DMH 7	0.344	0.85	0.292	0.292	5.40	1.59	5.00	0.020000	15 inch	0.013	9.14	16.50	16.40	19.50	19.80	1.75	2.15	17.00	16.80	
P20	DMH 7	STC 2				3.799	4.79	18.32	35.00	0.005714	24 inch	0.013	17.10	13.40	13.20	19.80	20.50	4.40	5.30	15.10	14.74	
P21	STC 2	O-1				3.799	4.76	18.23	10.00	0.015000	24 inch	0.013	27.71	12.95	12.80	20.50	21.00	5.55	6.20	14.49	14.15	STORMCEPTOR
P22	CB 11	DMH 10	0.351	0.65	0.228	0.228	5.40	1.24	155.00	0.005161	12 inch	0.013	2.56	17.30	16.50	20.30	21.00	2.00	3.50	17.79	16.97	
P23	CB 12	DMH 10	0.385	0.67	0.258	0.258	5.40	1.40	20.00	0.005000	12 inch	0.013	2.52	15.20	15.10	17.80	21.00	1.60	4.90	15.74	15.66	
P24	DMH 10	DMH 11				0.486	5.24	2.57	185.00	0.005405	15 inch	0.013	4.75	15.00	14.00	21.00	23.00	4.75	7.75	15.66	14.64	
P25	DMH 11	DMH 12				0.486	5.09	2.49	115.00	0.005217	15 inch	0.013	4.67	13.90	13.30	23.00	20.40	7.85	5.85	14.55	14.19	
P26	CB 13	DMH 12	0.177	0.90	0.159	0.159	5.40	0.87	5.00	0.040000	12 inch	0.013	7.13	17.20	17.00	20.20	20.40	2.00	2.40	17.59	17.27	
P27	ROOF 3	DMH 12	0.539	0.90	0.485	0.485	5.40	2.64	40.00	0.010000	12 inch	0.013	3.56	17.00	16.60	22.00	20.40	4.00	2.80	17.70	17.24	
P28	DMH 12	STC 3				1.131	4.96	5.65	50.00	0.005000	18 inch	0.013	7.43	13.20	12.95	20.40	21.50	5.70	7.05	14.19	14.02	
P29	STC 3	O-2				1.131	4.90	5.59	15.00	0.006667	18 inch	0.013	8.58	12.70	12.60	21.50	22.00	7.30	7.90	14.02	14.00	STORMCEPTOR
P30	DCB 15	DMH 13	0.732	0.35	0.256	0.256	5.40	1.39	185.00	0.005405	12 inch	0.013	2.62	14.00	13.00	17.00	17.80	2.00	3.80	14.52	14.17	
P31	DCB 16	DMH 13	1.128	0.69	0.778	0.778	5.40	4.24	10.00	0.030000	12 inch	0.013	6.17	14.40	14.10	17.40	17.80	2.00	2.70	15.27	14.79	
P32	DMH 13	O-3				1.035	5.16	5.38	25.00	0.012000	15 inch	0.013	7.08	12.90	12.60	17.80	19.00	3.65	5.15	14.17	14.00	

Recharge Calculations

VHB *Computations*

Project: 150/200 INNER Belt Project # 07027.00
Location: Somerville, MA Sheet 1 of 1
Calculated by: RPM Date: 5/8/00
Checked by: Date:
Title INFILTRATION VOLUME

ACCORDING TO SOMERVILLE ZONING ORDINANCE (SZO), THE DRAINAGE SYSTEM NEEDS TO PROVIDE A NO NET-INCREASE IN AMOUNT & VELOCITY OF STORM WATER RUNOFF. ALSO NEED TO MATCH PRE (AND POST PEAK DISCHARGE RATES.

USING HYDROCAD TO ANALYZE VOLUMES

EVENT	VOL PRE-DEVELOPED	VOL POST-DEVELOPED
2 year	1.32 AC-FT	1.56 AC-FT
10 year	2.12 AC-FT	2.35 AC-FT

LARGEST Δ = 0.24 AC-FT
≈ 10,454 CF.

ACCORDING TO STORMWATER MANAGEMENT POLICY, THE SUGGESTED INFILTRATION VOLUME FOR A SITE WITH SOIL GROUP B IS 0.25" TIMES THE IMPERVIOUS AREA. (7.6AC impervious)

$$0.25'' \times \left(\frac{1\ FT}{12''}\right) \times (331056\ SF) = 6,897\ CF$$

331056 SF = 7.6AC

* NEED TO MEET SZO FOR INFILTRATION REQUIREMENTS.

VHB *Computations*

Project: 150/200 INNER Project # 07027.00
Location: SOMERVILLE MA Sheet 1 of 1
Calculated by: RPM Date: 5/19/00
Checked by: Date:
Title INFILTRATION SYSTEM SIZING

Required volume to be recharged.

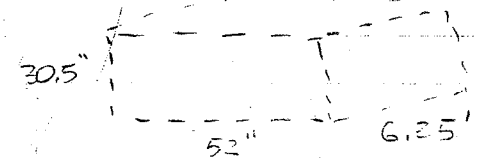
DIFFERENCE BETWEEN PRE & POST 24 HOUR RAIN FALL VOLUMES

EX 2YEAR VOLUME = 1.32 AF
PROP 2YEAR VOLUME = 1.56 AF

DIFF = 0.24 AF

0.24 x 43560 = 10454 CF

SIZE CULTEC "RECHARGER 330" TRENCH REQUIRED



EACH RECHARGER 330 UNIT HAS 48 CF STORAGE/UNIT

2' STONE ON SIDES/6" STONE UNDER 101 CF STONE/UNIT
101 CF STONE x 0.35 = 35 CF STORAGE IN STONE/UNIT

∴ EACH UNIT WITH STONE HAS 83 CF STORAGE

UNITS NEEDED = VOL REQ'D ÷ VOL per UNIT

= 10454 CF ÷ 83 CF

= 125.95 UNITS

NEED APPROX 788 L.F. OF TRENCH.

Appendix E:
BMP Maintenance/ Evaluation Checklist

150/200 Inner Belt Road Somerville, MA

Best Management Practices – Maintenance/ Evaluation Checklist

Long Term Practices

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐ no (List Items)	Date of Cleaning/Repair	Performed by
Water Quality Swale	Semi-annually						
Water Quality Structure	Semi-annually						
Sedimentation Trap	Monthly						
Deep Sump and Hooded Catch basin	Monthly						
Street Sweeping	20 times a year minimum						

Stormwater Control Manager _____

150/200 Inner Belt Road Somerville, MA

Best Management Practices – Maintenance/ Evaluation Checklist

Construction Practices

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐no (List Items)	Date of Cleaning/Repair	Performed by
Hay Bales/Silt Fencing	Weekly and after storm events						
Gravel Construction Entrance	Weekly and after storm events						
Catch Basin Protection	Weekly and after storm events						
Temporary Sedimentation Basins	Weekly and after storm events						
Vegetated Slope Stabilization	Weekly and after storm events						

Stormwater Control Manager _____

VHB
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Watertown, Massachusetts 02471
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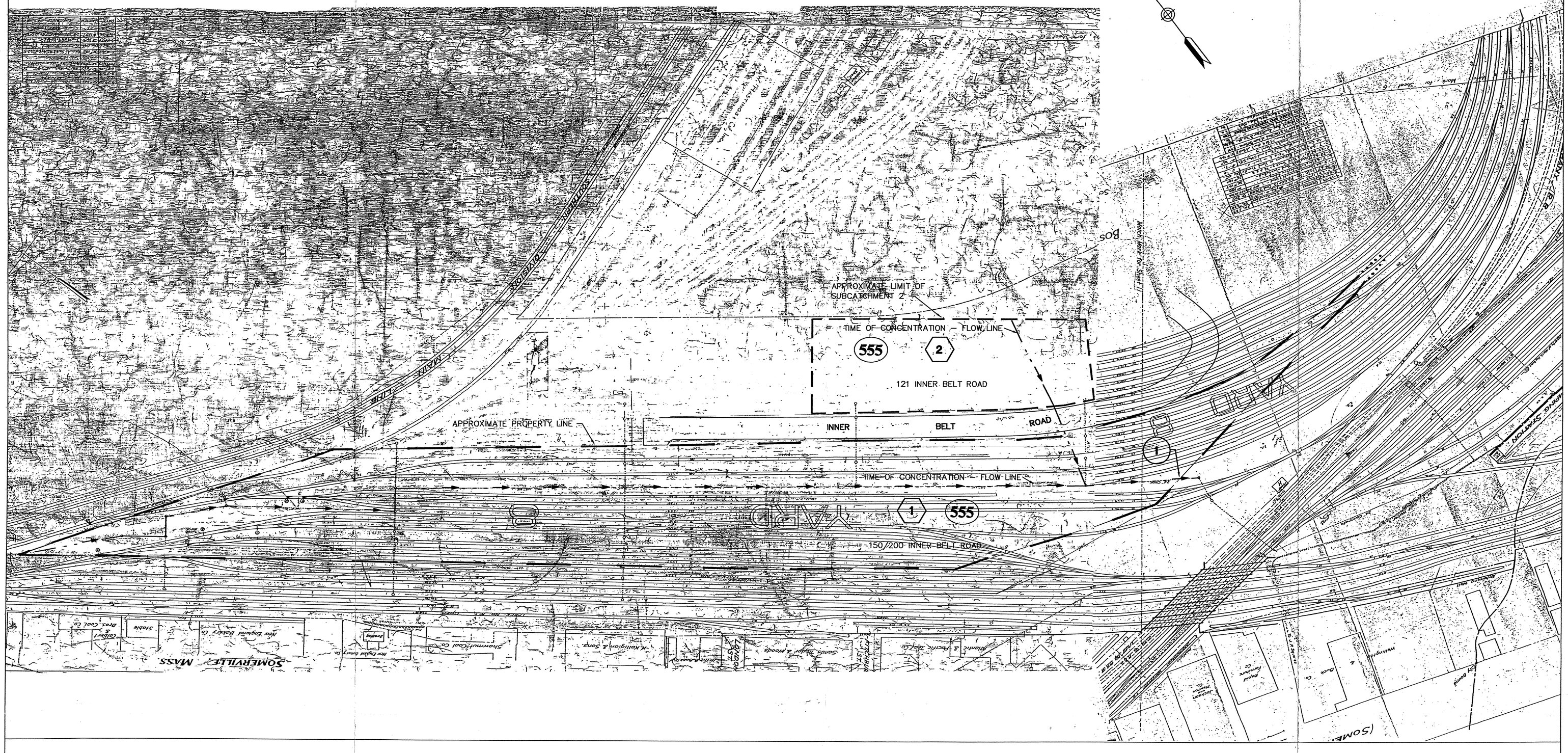


LEGEND

- 1 — POND DESIGNATION
- 1 — REACH DESIGNATION
- 1 — DRAINAGE AREA DESIGNATION
- 1 — DESIGN POINT DESIGNATION
- DRAINAGE AREA BOUNDARY
- TIME OF CONCENTRATION FLOW LINE

NRCS SOIL CLASSIFICATIONS

555 — UDORTHENTS, WET SUBSTRATUM

PLAN REFERNCES:

1. "BOSTON AND MAINE R.R. YARD AT BOSTON, MA" VALUATION MAPS V1-5 AND V1-11, SEPT. 12, 1979

No.	Revision	Date	Appvd.

Designed by	Drawn by	Checked by	
CAD checked by		Approved by	
Scale 1"=80'		Date 5/23/00	

Project Title
150/200
Inner Belt Road

Somerville, Massachusetts

Issued for
Drawing Title
Drainage Review

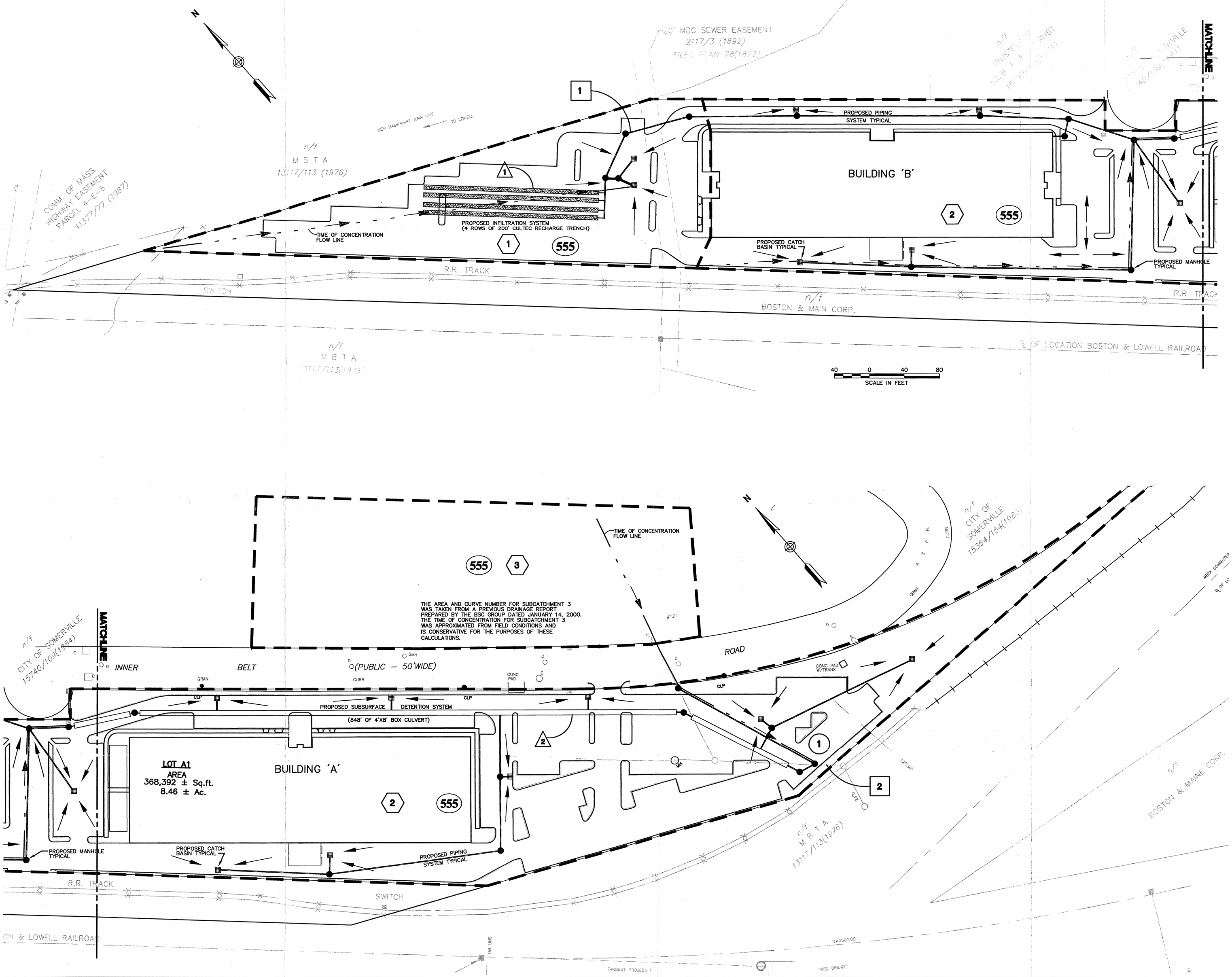
Pre-Existing
Drainage Areas

Drawing Number
Fig.-2

Sheet 1 of 1

Project Number
07027

Figure2.dwg



VHB

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Land Development
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REFERENCES

BSC GROUP

150 & 200 INNER BELT ROAD EXISTING CONDITIONS PLAN, DATED 01–14–99.

GUNTHER ENGINEERING, INC.

DWG 282.04M SUBDIVISION PLAN OF LAND, DATED MAY 25 1999.

DWG 282.07M ALTA/ACSM LAND TITLE SURVEY, DATED 29 JULY 1999.

LEGEND

- 1 — POND DESIGNATION
- 1 — REACH DESIGNATION
- 1 — DRAINAGE AREA DESIGNATION
- 1 — DESIGN POINT DESIGNATION
- DRAINAGE AREA BOUNDARY
- TIME OF CONCENTRATION FLOW LINE
- DRAINAGE FLOW PATH

NRCS SOIL CLASSIFICATIONS

555 — UDORTHENTS, WET SUBSTRATUM

No.	Revision	Date	Appvd.

Designed by	Drawn by	Checked by
CAD checked by	Approved by	
Scale 1"=40'	Date 5/23/00	

Project Title

150/200
Inner Belt Road

Somerville, Massachusetts

Issued for

Drainage Review

Drawing Title

Proposed
Drainage Areas

Drawing Number

Fig.-3

Sheet 1 of 1

Project Number
07027

Figure3.dwg